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Current Science, Vol. XVIII, 1949

Author Index

	PAGE		PAGE
AGARWAL P. N.	294	DABADGHAO P. M.	380
Ahmed F. and Bal D. V.	179	Dalai N. B. and Shah R. C.	440
Aiyappan A. (Rev.)	314	Das S. C. and Motiramani D. P.	46
Alikunhi K. H.	11	Dastur, Noshir N. (Rev.)	92
A. K. Y. (Rev.)	56	Datta N. C., Krishnan L. S. and Radha-	
Appanna M.	25, 403	krishna Rao M. V.	108
Ananda Rao T. and Govindu H. C.	260	Dave L. D. and Shah N. M.	361
Anantha Rao N. K. and Om Prakash		Davis A. Trupapur	133
Gautam	80	De N. N. (Rev.)	55, 91, 386
Ananthachar V. S.	374	De N. N.	115, 117
Anantkrishnan S. V. (Rev.)	57, 309	De N. N., Iyer B. H., Guha P. C.,	
Ananthapadmanabha Rau	119	Bami H. L., Natarajan S. and	
Ayyar C. C.	272	Ramaswamy A. S.	50
Azad, Hon'ble Maulana Abul Kalam	397	Deliwala C. V., Ganapathi K. and Raja-	
		gopalan S.	233
BAGAL S. R. and Trehan K. N.	127	Deoras P. J.	445
Bal D. V. and Ahmed F.	179	Desai C. M. and Vyas M. T.	49
Baman T. J.	313	Deshmukh D. J. and Mene P. S.	373
Bami H. L., Natarajan S., Rama-		Deshpande R. B.	171
swamy A. S. and De N. N.	50	Dey, Arun K.	123, 132
Bami H. L.	77	Dey B. B. (Rev.)	88
Banerji B. K.	292	Dey B. B., Friedmann H. C. and	
B. C. C. (Rev.)	22	Sivaraman C.	4
Bharat Bhushan, Joshi M. L., Vergheze		Dhonde G. W., Patel M. K. and Kul-	
James and Sondhi H. K.	205	karni Y. S.	171
Bhatnagar S. S.	429	Doraiswami M. S.	42
Bhatnagar S. S., Kothare, A. N., Fernan-		Dutt M. K.	411
des F. and Nadkarny V. V.	441	Dutt N. L. and Narasimhan R.	346
Bhatt Hariprasad A. and Kamath N. R.	331		
Bhat J. V. and Reporter, Roda N	9	FERNANDES F., Nadkarny V. V., Bhatnagar	
Bhat J. V.	177	S. S. and Kothare A. N.	441
Bhimasenachar J. and Seshagiri Rao T.	372	Fernando I. and Krishnamurty S. G.	371
Bhimachar B. S.	456	Friedmann H. C., Dey B. B., and Siva-	
Bhimasenachar J.	373	raman C.	4
B. K. M. (Rev.)	141, 456		
B. K. N. (Rev.)	24	GADADHAR MISRA	413
B. N. N. (Rev.)	25	Ganapathi K., Rajagopalan S. and Deli-	
Bohr, Prof. Niels	106	wala C. V.	233
Bose M. N.	246	Ganapathi S. V. and Chacko P. I.	257
Bose S. K. and Mathur S. R.	210	Garga R. P., Azad R. N. and Vasu-	
Bose, Prof. Nirmal Kumar	65	deva R. S.	411
Brahmaji Rao V. and Gopala Rao G.	124	Ganguly P. B.	68
Brahmaji Rao V., Narasimha Sastri M. and		Garga R. P.	260
Gopala Rao G.	381	George P. C.	448
Brown D. T.	180	Gharpure M. B. and (Mrs.) Ranita	
B. S. G. (Rev.)	357	Aiman	303
CAPOOR S. P.	82	Ghosh J. C. (Rev.)	433
Cawston, F. Gordon	8	Giri K. V. (Rev.)	23
C. G. (Rev.)	27, 139, 262, 391	Giri K. V. and Sri Ram J.	440
Chacko P. I. and Ganapathi S. V.	257	G. N. R. (Rev.)	453
Chacravarti A. S. and		Gopala Rao G., Brahmaji Rao V. and Nara-	
Khanna K. L.	19, 127, 340, 443	simha Sastri M.	381
Chalam G. V.	401	Gopala Rao G. and Brahmaji Rao V.	124
Chandrashekhara Aiyar S. V. (Rev.)	354, 419	Gopala Rao G. and Narasimha Sastri M.	402
Channaveriah M. S.	208	Gopala Rao G. and Ramanjaneyulu J.V.S.	72
Chhibber H. L.	290, 437	Gopalswamy S. N., Jatkar S. K. K., and	
Chinoy J. J.	414	(Miss) Kulkarni S. B.	131
Chiplonkar M. W.	368	Govindan Nair K. N.	238
C. N. S. (Rev.)	23, 263, 384	Govindarajan V. S., Sreenivasaya M.,	
C. S. V. (Rev.)	24	Ram Mohan R., and Thadani K. C.	427
C. S. G. (Rev.)	388	Govindu H. C.	180

AUTHOR INDEX

[Vol. XVIII]

	PAGE		PAGE
Govindu H. C. and Ananda Rao T. . .	260	(Miss) Kulkarni S. B., Gopalaswamy	
Guha P. C. and Gupta P. R. . .	294	S. N., and Jatkar S. K. K. . .	131
Guha P. C., Raghavan M. and Iyer		(Miss) Kulkarni S. B. and Jatkar	
B. H. . .	75	S. K. K. . .	76, 130
Guha P. C. (Rev.) . .	313	Kulkarni S. A., Thakor V. M. and	
Gulati K. C., Joshi M. L. and Verghese		Shah R. C. . .	444
James . .	17	Kulkarni Y. S., Dhande G. W. and	
Gundu Rao C. . .	187	Patel M. K. . .	83, 171
Gupta P. R. and Guha P. C. . .	294	Kulkarni H. L. and Trehan K. N. . .	78
Gupta I. S. and Khanna M. L. . .	244	Kumar L. S. S. . .	390
Gururaja Doss K. S. (Rev.) . .	310	Kumar L. S. S. (Rev.) . .	138, 262
		Kuriyan G. K. . .	134, 258
HALLEPPANAWAR N. L. and		K. V. (Rev.) . .	89, 137, 351
Trehan K. N. . .	212		
Hansraj Gupta . .	119, 241	LAKSHMIKANTHAN J. and Mohan Babu	
Hora S. L. . .	157	Naidu . .	299
H. R. (Rev.) . .	25	Lakshminarasu S. (Rev.) . .	221
		Lal K. N. . .	241
INDERJIT SINGH (Rev.) . .	139, 355	L. S. (Rev.) . .	353, 419
Inderjit Singh and Sunita Inderjit Singh . .	155	L. S. R. (Rev.) . .	93, 140, 263
Iyengar M. O. P. . .	158		
Iyer B. H. . .	282, 391	MAHABALE T. S. . .	449
Iyer B. H. (Rev.) . .	356	Mahadevan C. and Prabhakara Rao G. . .	169
Iyer R. N., Shah K. H. and Venkata-		Mahadevan C. . .	112
raman K. . .	406	Mahajan L. D. and Mathur O. C. . .	204
Iyer B. H., Guha P. C., Bami H. L.		Malurkar S. L. . .	5
Natarajan S. Ramaswamy A. S. and		Mann, P. F. E., Ranganathan, S. K.,	
De N. N. . .	50	Subramanyan T. S., Padmanabhan	
Iyer B. H., Guha P. C. and		T. S. A. and Sud L. R. . .	47
Raghavan M. . .	75	Mathew K. K. and Menon K. N. . .	374
		Mathur O. C. and Mahajan L. D. . .	204
JATKAR S. K. K. and (Miss) Kul-		Mathur S. R. and Bose S. K. . .	210
karni S. B. . .	130	M. C. M. (Rev.) . .	420
Jatkar S. K. K. (Miss) Kulkarni S. B.		Mahdihassan S. . .	347
and Gopalaswamy S. N. . .	131	Mehrotra B. S. . .	446
J. B. (Rev.) . .	311	Mene P. S. and Deshmukh D. J. . .	373
Jenkin T. J. . .	414	Menon K. N., Mathew K. K. . .	374
Joseph K. V. . .	173	Menon K. N., Raman P. S. and Kartha	
Joshi G. G. and Shaw N. M. . .	73	A. R. S. . .	8
Joshi M. L., Verghese, James and		Menon K. P. . .	67, 93, 94, 111
Gulati K. C. . .	17	Menon K. P. (Rev.) . .	186, 311, 455
Joshi M. L. Verghese, James, Sondhi		Menon P. S., Venkatachalam P. S. and	
H. K., and Bharat Bhushan . .	205, 207	Sarma P. S. . .	367
		Mene P. S. and Warhadpande V. R. . .	296
KACHROO P. . .	299	Misra R. C. . .	438
Kale G. T. . .	429	Misra S. S. and Narayana Rao S. R. . .	330
Kalra S. L. and Rao K. N. A. . .	249	Mohan Babu Naidu and Lakshmi-	
Kamath N. R. and Bhatt Hari-		kanthan J. . .	299
prasad A. . .	331	Moorjani M. N. and Subrahmanyam V. . .	128
Kartha A. R. S., Menon K. N. and		M. R. A. (Rev.) . .	55, 184, 358
Raman P. S. . .	8	M. R. N. (Rev.) . .	453
K. C. . .	118	M. R. R. (Rev.) . .	355
Kehar N. D. and Sahai B. . .	325	Mukerji S. . .	255
Khanna K. L. and Chacravarti		Mukerji S. K., Shrikhande J. G., and	
A. S. . .	19, 127, 340, 443	Pathak A. N. . .	375
Khanna M. L. and Sharma S. L. . .	129	Murgai M. P. . .	120
Khanna M. L. and Gupta I. S. . .	244	Murthy D. V. and Rao A. S. . .	342
Khoshoo T. N. . .	12	Murthy T. K. S. and Raghava Rao	
Kothare A. N., Fernandes F., Nadkarny		Bh. S. V. . .	248
V. V. and Bhatnagar S. S. . .	441	Mushran S. P. . .	48, 247
Krishnamurthy S. G. and Fernando I. . .	371	M. V. S. (Rev.) . .	337, 420
Krishnamurthy V. N. . .	373, 406		
Krishnan L. S., Radhakrishna Rao M. V.		NADKARNY V. V. . .	261
and Datta N. C. . .	108	Nadkarny V. V., Bhatnagar S. S.,	
Krishnan R. S. . .	3	Kothare A. N., and Fernandes F. . .	441
Krishnaswamy N., and Raman		Naganna B. . .	207
V. S. . .	15, 376	Naganna B. and Ramachandra Rao P. . .	250
Krishnaswamy S. . .	78	Nagaraja Sarma R. (Rev.) . .	432
K. S. G. D. (Rev.) . .	454	Naidu P. R. J. . .	43, 289
Kuldip Chand Chadha . .	202	Nair V. S. . .	40

	PAGE		PAGE
Nambudripad M. C.	166	Rai Choudhury A. K.	334
Narain R. D.	41, 243	Rajagopalan S., Deliwala C. V. and Ganapathi K.	253
Narasimhan M. J. and Thirumala char M. J.	252	Raja Rao K. S.	121
Narasimhan R. and Dutt N. L.	346	Rajasekdhara Mudaliar C. and Daniel D. Sundararaj	301
Narasimha Sastri M., Gopala Rao G. and Brahmaji Rao V.	381	Ramachandra Rao P. and Naganna B.	250
Narasimha Sastri M. and Gopala Rao G.	402	Ramakrishna P. A.	307
Narasimha Sastri M. and Ramanjaneyulu J. V. S.	52	Ramakrishna Rao V.	72, 168, 245, 338, 435
Narayana Rao S. R. and Mirsa S. S.	380	Ramakrishnan T. S. and Reddy G. S.	416
Narayan Nambiar V. P.	245, 284, 286	Ram Mohan R., Thadani K. C., Govindarajan., V. S. and Sreenivasaya M.	427
Natarajan C. V. (Rev.) z z.	21	Ramamurthi K. S.	148
Natarajan S., Ramaswamy A. S., De N. N., Iyer B. H., Guha P. C. and Bami H. L.	50	Ramamurthi M. V.	416
Nayar M. R.	231	Raman C. V.	158
Nigam R. G. S., Pandya K. C. and Tayal J. N.	451	Raman P. S. and Kartha A. R. S., and Menon K. N.	8
Nijbawan B. R.	195, 235	Raman V. V. and Sitaraman M. V.	44, 291
Nijbawan B. R. (Rev.)	133, 266	Raman V. S. and Krishna-swamy N.	15, 376
Nirody B. S. (Rev.)	356	Ramanathan K. R.	398
N. K. P. (Rev.)	310, 457	Ramanathan K. and Sampath S.	408
OM PRAKASH	337, 400	Ramanjaneyulu J. V. S. and Gopala Rao G.	72
Om Prakash Gautam and Anant Rao N. K.	80	Ramanjaneyulu J. V. S. and Narasimha Sastry M.	52
PADMANABHAN T. S. A., Sud, L. R., Mann P. F. E., Ranganathan S. K. and Subramanyam T. S.	47	Rama Pai	69
Padmanabhan V. M.	287	Rama Rau L.	199
Padmanabhan S. Y.	443	Ramaseshan S. (Rev.)	24
Palit Santi R. and Ranajit Sengupta	206	Ramaswamy A. S., De N. N., Iyer B. H., Guha P. C., Bami H. L., and Natarajan S.	50
Pande K. K., Pathak G. N., Singh B., Tiwari K. M. and Srivastava A. N.	347	Ranajit Sengupta and Palit Santi R.	206
Pandya K. C., Nigam R. G. S., and Tayal J. N.	451	Randhawa M. S.	279
Panje R. R.	18	Ranganathan S. (Rev.)	457
Parsons, Arthur C.	240	Ranganathan S. K., Subramanyam T. S., Padmanabhan T. S. A., Sud L. R., and Mann P. F. E.	47
Parthasarathy S. V.	172	(Mrs.) Ranita Aiman and Gharpure M. B.	303
Parvatikar K. G.	288	Rao A. R.	158, 349, 447
Pathak A. N., Mukherji S. K. and Shrikhande J. G.	375	Rao A. S. and Murthy D. V.	342
Pathak K. N. and Singh B. B.	253	Rao K. N. A. and Kalra S. L.	249
Pathak G. N., Singh B., Tiwari K. M., Srivastava A. N. and Pande K. K.	347	Rao K. R. and Sreeramamurthy K.	418
Patel M. K.	83, 213	Rao M. B. R.	186
Patel M. M.	436	Rao M. B. R. (Rev.)	224, 264, 265
Patel M. Y., Kulkarni K. S. and Dhande G. W.	83, 171	Razi B. A. and Safeeulla K. M.	258
Pattanaik Shyamanand	212	Razi B. A. and Subramanyam K.	178
Patwardhan V. N. (Rev.)	221	Reddy G. S. and Ramakrishnan T. S.	416
Pillai S. C.	382	Reddy D. V. S.	425
P. R.	370	Reporter Roda N. and Bhat J. V.	9
Prabhakara Rao G. and Mahadevan C.	169	R. G.	71
Prasad S. R. (Rev.)	354	Richharia R. H.	253
P. S. S. (Rev.)	185	Roonwal M. L.	39
RADHAKRISHNA RAO M. V., Datta N. C. and Krishnan L. S.	108	R. S. K. (Rev.)	54, 92, 136, 220, 232, 262, 420, 452
Raghava Rao B. S. V. and Venkataramaniah M.	170, 248, 450	S. A. (Rev.)	20, 222
Raghava Rao B. S. V. and Murthy T. K. S.	248	Sadasivan T. S.	158
Raghavan M., Iyer B. H. and Guha P. C.	75	Safeeulla K. M. and Razi B. A.	258
Raghavendra Rao M. R. and Sreenivasaya M.	250	Safeeulla K. M. and Govindu H. C.	414
		Sahai B. and Kehar N. D.	325
		Sahni, Professor Birbal	396
		Schouten S. L.	34
		Sampath S. and Ramanathan K.	408
		Samuel Raj J. and Verghese K. V.	416
		Saraiya P. R. and Shah R. C.	218
		Saran A. B.	378
		Sarkar B. B.	117
		Sarma P. S. (Rev.)	183

	PAGE		PAGE
Śarma P. S. and Menon P. S., and Venkatachalam P. S. ..	367	Sundararaj D. Daniel and Rajasekhara Mudaliar ..	301
Sastry S. G. (Rev.) ..	86, 386	Sundara Rao, R. V. G. ..	336
Sastry S. L. ..	305	Sunil Kumar Mukherjee ..	430
Sathe V. R. and Venkataraman K. ..	373	Sunita Inderjit Singh and Inderjit Singh ..	155
Satya Parakath and Tej Narain Shivapuri ..	403	Suryan G. ..	203
Saurindranath Sen ..	328	Syed Usman L. ..	407
Sen B. ..	152		
Sen J. ..	254	TAYAL J. N., Nigam R. G. S. and Pandya K. C. ..	451
Sengupta S. ..	333	Tej Narain Shivapuri and Satya Prakash ..	403
Seshagiri Rao T. and Bhimasenachar J. ..	372	Tewari B. ..	401
Seshagiri Rao T. ..	436	Thacker M. S. (Rev.) ..	26
Seshaiya R. V. ..	84	Thakor V. M., Shah R. C., and Kulkarni S. A. ..	444
Sethna S. and Trivedi P. L. ..	442	Thadani K. C., Govindarajan V. S., Sreenivasaya M. and Ram Mohan R. ..	427
Shah K. H. Venkataraman K. and Iyer R. N. ..	406	Thirumalachar M. J. ..	16, 175
Shah N. M. and Dave L. D. ..	381	Thirumalachar M. J. and Narasimhan M. J. ..	252
Shah N. M. and Joshi G. G. ..	73	Tiruvenganna Rao P. ..	8, 42, 245
Shah N. M. and Vyas G. N. ..	134	Tiwari K. M., Srivastava A. N., Pande, K. K., Pathak G. N. and Singh B. ..	347
Shah R. C., Kulkarni S. A., and Thakor V. M. ..	444	Trehan K. N. and Hallappanawar N. L. ..	211
Shah R. C. and Saraiya P. R. ..	218	Trehan K. N. and Kulkarni H. L. ..	78
Shah R. C. and Dalal N. B. ..	440	Trehan K. N. and Bapal S. R. ..	126
Shamshad M. ..	336	Trivedi D. M. and Vakilwalla M. V. ..	406
Sharma S. L. and Khanna K. L. ..	129	Trivedi P. L. and Sethna S. ..	442
Shrikanth J. G., Pathak A. N. and Mukerji S. K. ..	375	T. S. S. (Rev.) ..	90
Shri Ranjan ..	158		
Shyamand Pattanaik ..	212	UTTAMAN P. ..	52, 215, 251, 297, 343, 445
Singh B. B. and Pathak G. N. ..	253	VAIDYA B. K. (Rev.) ..	136
Singh B., Tiwari K. M., Srivastava A. N., Pande K. K. and Pathak G. N. ..	347	Vaidyanathan D. ..	345
Sinha S. P. ..	168	Vakilwalla M. V. and Trivedi D. M. ..	406
Sita E. (Mrs.) ..	216	Vasudeva R. S. ..	114
Sitaraman M. V. and Raman V. V. ..	44, 291	Vasudeva R. S., Garga R. P. and Azad R. N. ..	411
Sivaraman C., Dey B. B. and Friedmann H. C. ..	4	Velappan Nair R. ..	9
S. K. C. (Rev.) ..	183, 389	Venkatachalam P. S., Sarma P. S. and Menon P. S. ..	367
Sondhi H. K., Bharat Bhushan, Joshi M. L. and Verghese James ..	74, 205, 207	Venkataraman K. (Rev.) ..	27
Soparkar M. B. ..	115	Venkataraman K. and Sathe V. R. ..	373
Sreenivasaya M. and Raghavendra Rao M. R. ..	250	Venkataraman K., Iyer R. N. and Shah K. H. ..	406
Sreenivasaya M. and Srivatsava A. S. ..	36	Venkataraman T. S. ..	32, 218, 258
Sreenivasaya M., Ram Mohan R., Thadani K. C. and Govindarajan V. S. ..	427	Venkataramaniah M. and Raghava Rao Bh. S. V. ..	170, 248, 450
Sreeramamurthy K. and Rao K. R. ..	418	Venkataraman L. ..	409
Sreeramamurthy K., Sri Ram J. and Giri K. V. ..	440	Venkataraman S. V. ..	13, 14, 455
Srinagabhushana (Rev.) ..	223, 357	Venkataramayadu (Rev.) ..	135
Sri Ram J. and Narasimha Rao P. L. ..	404	Verghese, James ..	315
Srivastava A. N., Pande K. K., Pathak G. N. Singh B. and Tiwari K. M. ..	347	Verghese James, Gulati K. C. and Joshi M. L. ..	17
Srivastava A. S. and Sreenivasaya M. ..	36	Verghese James, Sondhi H. K., Bharat Bhushan and Joshi M. L. ..	74, 205, 207
Subbramaiya D. S. (Rev.) ..	353	Viswanathiah M. N. ..	339
Subramanyam K. ..	415	V. N. K. ..	230
Subramanyam K. and Razi B. A. ..	178	Vyas M. T. and Desai C. M. ..	49
Subramanyam T. S., Padmanabhan T. S. A., Sud L. R., Mann P. F. E. and Ranganathan S. K. ..	47	Vyas G. N. and Shah N. M. ..	134
Subrahmanyam V., and Moorjani M. N. ..	128		
Sud L. R., Mann P. F. E., Ranganathan S. K., Subramanyam T. S. and Padmanabhan T. S. A. ..	47	WARHADPANDE V. R. and Mene P. S. ..	296
Sundararaj B. ..	303	Wolsky, Alexander ..	323
		YEDDANAPALLI L. M. (Rev.) ..	385

Subject Index

	PAGE		PAGE
ABORIGINAL tribes of Madras, Report on Socio-Economic Conditions (Rev.) ..	357	Atomic Energy Commission ..	68
Absorption Spectrum, Ultra-violet of Iodobenzene ..	418	— — — India ..	59
Acanthocephala, <i>Moniliformis moniliformis</i> (Bremser, 1811) Life Cycle of ..	216	Australia, Indian Scientists to Tour ..	30
Accidents, Electrical (Rev.) ..	25	Australian Tour of Indian Scientists ..	150
Acetic Acid Estimation in Pyroligneous Liquors ..	296	Award for Wool Research ..	392
Activated Sludge, Nature of, and Bearing on Dewatering the material ..	362	Azo-dyes, Electrolytic Preparation of, Part III: Dye formation at an Iron Anode ..	291
Acetylation in the Laboratory Diagnosis of "Burning Feet Syndrome" (Pantothenic Acid Deficiency) ..	367	BACTERIOLOGY, A Text Book of (Rev.) ..	186
Adsorption of Gases on Solids (Rev.) ..	453	<i>Bagarius bagarius</i> (Ham.) Food of the Goonch ..	134
Advanced Studies in U. S. A., Facilities for ..	421	Bamboo, Effect of Ergot on ..	344
Adventure of Education ..	194	— X Sugarcane Hybrids ..	218
Agricultural Meteorology and Hydrology ..	60	Bands, New, of Columbium Oxide ..	168
— Statistics—India Society of ..	107	Band Spectrum of Chromium Bromide ..	338
Ajowan Seeds, Thymol from ..	17	— — — Chloride ..	72
Alga, Oil-bearing, from Palana Lignite (Eocene) of Rajputana ..	380	— — — Tantalum Oxide ..	371
Alkali Chlorides, Effect of, on the Intensity of Cyanogen Bands in Carbon Arc ..	373	— — — TiCl ..	245
α -Naphthylamine and Dichromate, and α -Naphthylamine and Vanadate, Reaction between, Influence of Hydrogen Carboxylic acids ..	48	Basis of Chemotherapy, (Rev.) ..	91
Amines, Diazotisation of, A New method ..	261	Bat, Ectoparasites of ..	179
Ammonia Accumulation by <i>Penicillium notatum</i> Westl., Influence of Carbohydrates on ..	446	Bee Compass ..	361
Amphidiploid of the Hybrid of <i>Pennisetum typhoides</i> Stapf. and Hubbard \times <i>P. purpureum</i> Schumach ..	15	— Research Station for India ..	36
Angiospermic Remains of Barmer Sandstones ..	246	Beginnings of Modern Medicine in Madras (Rev.) ..	24
Angiospermous Plants, Chromosome Numbers in Some ..	347	Benares Hindu University ..	30
Angular Leaf-spot of Kudzu in Mysore ..	16	Berek's Compensator ..	289
Animal Husbandry Wing, I.C.A.R. Meeting ..	64	Bibliography, Regional Scientific, for S. E. Asia ..	370
— Life, The Science of (Rev.) ..	140	Biguanidine Derivatives, Antimalarial, Screening Tests of Some ..	50
Annandale, Thomas Nelson (Obituary) ..	157	Biochemical Congress ..	422
Anniversary, 200th, of Edward Jenner ..	227	Biochemical and Allied Research in India, Annual Review, Vol. 18 (Rev.) ..	457
Annual Reviews—New ..	38	— Evolution (Rev.) ..	221
Anti-Histomine Activity of Substituted Benzhydryl Amines ..	303	Biochemistry at Cambridge ..	317
— Malarial Screening Tests of Some Biguanide Derivatives ..	50	—, Comparative, An Introduction to (Rev.) ..	355
— Rust Research ..	143	Biological Assay, The Principles of (Rev.) ..	55
<i>Anthoceros</i> , Tubers in a Species of ..	178	— Control of the <i>Striga</i> ..	445
Anthranilic Acid, Synthesis of Saccharin from ..	440	— Reactions caused by Electric Currents and X-rays (Rev.) ..	139
Apatite gypsumification in Kodurites ..	169	— Sciences, Conferences on ..	30
Applied Mathematics—Elasticity—Third Symposium ..	327	Biology, and Medicine, and Colloids ..	68
Aquametry (Rev.) ..	358	— of Melanomas (Rev.) ..	21
Arboretum, Los Angeles ..	227	Birds in Britain (Rev.) ..	222
<i>Artocarpus integrifolia</i> , Linn. (Jack fruit tree) Sex Reversal in ..	14	Black-Water Fever, Specific for ..	460
Assay, Biological, Principles of (Rev.) ..	55	Boilers, British Designed ..	421
Association of Scientific Workers, India ..	59	Bond Energy and Ionic Characters of Hydrogen and Alkali Halides ..	131
Atomic Chemistry—Discussion by World Scientists ..	62	Bose Research Institute (32nd Anniversary) ..	459
Atomic Clock ..	322	<i>Botulinum bacilli</i> and Their Occurrence in Sweden ..	388
		<i>Brassica campestris</i> Linn. var. <i>sarson</i> Prain, Mutation in ..	253
		British Association for the Advancement of Science ..	268
		— Chemical Nomenclature (Rev.) ..	88
		— Industries Fair ..	105
		Building Research in India ..	432
		Bursa Copulatrix—Structure and Function and Associated Organs in Bruchidae (Lariidae) (Coleoptera—Phytophaga) and Their Taxonomic Significance ..	255

	PAGE		PAGE
CADINENIC Sesquiterpene, Raman Spectrum of	287	Chromosome Numbers in Northern Plant Species (Rev.)	138
Calcium, Dietary, From Crude Common Salt, in the case of S. Indian Diet	128	— — — Some Angiospermous Plants	347
Cancer Research Grant	199	— — — Economic Plants of India	376
<i>Capsicum annuum</i> var <i>grossa</i> Sendt., Tricotyly in	208	— of Cricket, <i>Liograllus bimaculatus</i>	411
<i>Carassius auratus</i> —Spawning Conditions and Larvicidal propensities in	257	Cicindelids from Krusadai Island and Kutikal Point in the Gulf of Mannar	416
Carbohydrate Biochemistry (Rev.)	23	<i>Cirrhina mrigala</i> (Hamilton), Occurrence in River Godavari	11
Carbohydrates, Influence of, on Ammonia Accumulation by <i>Penicillium notatum</i> Westl.	446	<i>Clostridium lacto-acetophilum</i> , Optimum pH of	177
Carbon Monoxide—Effect on the Respiration of Artificially Bivoltinized Silkworm Eggs	323	Cocoonut Palm Weevil pests (<i>Diocalandra stigmaticollis</i> Gyll.) in Travancore	173
— — — Isotopes	330	— Water and the Growth of Immature Embryos of Corn (Maize)	251
Carene Decomposition, Pyrogenic, in presence of Copper and Aluminium Catalysts	267	— — — Effects on Growth of Immature Corn (Maize) Embryos when Applied Before and After germination	343
Carnes to <i>p</i> -Cymene	74, 205	— Research Scheme, Ceylon	267
Carpet Beetle Damage to Telephone Wires	85	Colorado School of Mines Scholarship	143
Cashew Shell Oil—Dielectric Constants of	403	Coliform Bacteria in Water, A More Rapid Presumptive Test for	343
— Tree (<i>Anacardium occidentale</i> L.) Unrecorded Pest in S. India	133	Colorimetric Detection and Estimation of Thorium	248
Castor (<i>Ricinus communis</i> L.)—A New Leaf-spot Disease of	210	Colloids in Biology and Medicine	68
Catalase Activity of the Petals and Leaves of <i>Hibiscus rosasinensis</i>	212	Columbian Oxide, New Bands of	168
Catalysis, Advances in (Rev.)	219	Combustion Theory and Spectroscopy (Rev.)	54
Cathode, Perforated—A Note on the Self-quenching of	337	Common Salt—Crude, as Source of Dietary Calcium for S. Indians	128
Cation Exchange of Capacity of Different Mechanical Fractions of the Soil and its Organic Matters	375	Community at the Cross Roads, A	420
Caustic Embrittlement of Boiler Plate and Rivet Steel	275	Comparative Biochemistry, An Introduction to (Rev.)	355
CCRU Gift to Pasteur Institute	96	Conditioned Reflexes and Neuron Organisation (Rev.)	355
<i>Cedrus deodara</i> , Loudon, A Mutant of	12	Condon, Professor Edward	459
Cell Research	228	Conference on Biological Sciences	30
Cellulose, Irradiated, Alkali Sensitive Linkages in	47	<i>Cordyceps sphecocephala</i> (KL.) Sacc.—Occurrence near Calcutta	254
Central Potato Research Institute	362	Corn Hybrids of U.S.A., Trials of (Maize)	213
<i>Cercaria fraseri</i> Buckley (1939), Study of, in Madras	124	— (Maize) Culturing of Pro-embryos, Aged between 3 to 7 days in Normal Diploid Variety	215
<i>Cerebella</i> on Sugarcane	180	— Embryos, Immature: Effects of Coconut Water on Growth when Applied Before and After Germination	343
Cerimetry, Indicators in	450	— — — Viability of, Under Cold Storage at Freezing Point—Preliminary Investigation	52
Cetyl Pyridinium Bromide Solutions, Surface Tension of	292	Coronary Perfusion of the Mammalian Heart, Apparatus for	238
Chandrasekhar, Dr. Subramania	232	Corundum, Elastic Constants of	372
Chalkone Formation—Phosphorus Oxychloride, A New Condensing Agent for	134	Cosmic Ray Physics (Rev.)	354
Chapman, Professor, at Allahabad	30	Cotton White-Fly, Feeding methods of	82
Chemotherapy of Tuberculosis	233	Coumarins as New Indicators in Acidimetry and Alkalimetry	381
— The Basis of (Rev.)	91	Council of Scientific and Industrial Research	266
Chemical Engineers, Indian Institute of	29	‘Create More Wealth’ (Edtl.)	393
— Nomenclature, British (Rev.)	88	<i>Crotalaria juncea</i> , Dimorphism in the Stamens of	80
Chilli (<i>Capsicum annuum</i> L.), A Case of Simultaneous Mutations of two Independent Genes	171	Crystal Growth (Rev.)	452
Cholera through <i>Nira</i>	9	Crystals, Raman Spectra of, and Their Interpretation	3
Christiansen Experiment, The Theory of	232	Cultural Words of Chinese Origin—Monsoon	347
Chromatography (Rev.)	308	Cupric Hydroxide from Cupric Salts, Conditions of Precipitation of, by Soluble Hydroxides	123
Chromium Bromide, Band Spectrum of	338		
— Chloride, Band Spectrum of	72		
Chromones and iso-Flavones, A New Reaction for the Synthesis of	373		
Chromosome Numbers in Indian Economic Plants (iii)	408		

	PAGE		PAGE
<i>Cylas formicarius</i> F. (Sweet Potato Weevil) in Bombay—Life History, Bionomics and Control of	126	Editorial: Scientific Aspects of Silk Production	321
Cymene, p-, from Carenes	74	— Maximization of Scientific Effort	365
Cyanogen Bands in Carbon Arc, Effect of Alkali Chlorides on Band Intensity	373	— "Create More Wealth"	393
<i>Cyperus pangorei</i> , (Mat Sledge), Smut on	13	— Scientific Liaison	423
Cytology, General, Essentials of (Rev.)	391	Education, Rural Adult	397
DAIRY Products, Chemistry and Manufacture of Indian (Rev.)	92	Educational Institutions Abroad, Admission to	59
Dalal, Sir Ardeshir (Obituary)	390	Egerton Committee Report (Edtl.)	191
Date-Palm Juice (Sendhi), Micro-Organisms in	299	Einstein—Professor Albert: The Internationalist	106
Dating Methods, Improvement in	65	Elastic Constants of Corundum	372
D.D.T., Commercial, as Insecticide for Sugarcane	129	— — — Lithium Fluoride	336, 436
<i>Derris benthamii</i> , Occurrence of Hyaline Trabecular Cells in the Mesophyll of	260	— — — Sodium Chlorate and Sodium Bromate	204
Dialysis, Separation Processes Involving	305	Elasticity of Wood and Plywood (Rev.)	185
De-watering the Material, Bearing of Activated Sludge on	382	Electrical Accidents (Rev.)	25
Dielectric Constant of Ionic Solids	76	Electricity and Electromagnetism, Principles of (Rev.)	353
— — — Cashew Shell Oil	403	— — — Magnetism (Rev.)	453
Dietetic Hepatic Lesions and Protein Deficiency	108	Elliot Prize for Scientific Research	29
<i>Diocalandra stigmaticolis</i> , as Weevil Pest of Coconut-Palm in Travancore	173	<i>Elodea canadensis</i> , Occurrence of Turions in	414
Dimorphism in Stamens of <i>Crotolaria juncea</i>	81	Elsevier's Encyclopædia of Organic Chemistry Vol. 12 B: <i>Naphthalene</i> (Rev.)	357
Dinitration of Meta-Chloracetanilide	49	Embryo Culture to obtain F ₁ Plants of Incompatible Crosses in Corn Maize	297
Displaced Students, Facilities for	363	Emission Spectra of Lead Iodide	8
D-Mannitol,—Occurrence of, in the Exudation of <i>Olea glandulifera</i>	404	— — — Manganese Halides	245
<i>Dolichos biflorus</i> L.—A New Host of <i>Xanthomonas phaseoli sojense</i> (Hedges) Dawson	83	Engineers in India, Role of (Edtl.)	61
Drug Industry for India Modern (Edtl.)	31	Engineering and Marine Exhibition in London	317
D.Sc. Awards in Chemistry	422	E.N.T. Specialists Conference in London	318
— — — Spectroscopy	422	Entomological Society of India	97
Dye Chemistry, Fundamental Processes of (Rev.)	351	Entomology, IXth International Congress of	422
— Formation at an Iron Anode—Electrolytic Preparation of Azo-dyes Part III	291	Enzyme-Kinetics, Derivation of a General Equation for	334
Dyes and Dyeing, History of, in the Bombay Presidency (Rev.)	55	Enzymology, Advances in, Vol. VIII (Rev.)	308
Dyestuffs, Zero Conductance Temperature of Certain	403	Ergot on Bamboo	344
EARLINESS Index for Sugarcane	172	Erythrocyte Pyrophosphatase, Nature of Inhibition of, by Veronal-Acetate Buffer	207
Eastern Religions Professorship at Oxford	143	Escalator Method in Engineering	22
— Studies at Oxford	147	Excited States of Nuclei (Rev.)	452
Economic Plants of India, A Note on the Chromosome Numbers of some	376	Exhibition, 1851, Scholarship	237
— — in India, Chromosome Numbers, III	403	—, London's 1951	459
Ectoparasites, Two, of the Bat: <i>Rousettus leschenaulti</i> Desm.	179	FAR-EASTERN Conference on Forestry and Timber Utilisation (Edtl.)	101
Editorial: Quality in Scientific Research	1	Faraday Society Discussions (Rev.)	57
— A Modern Drug Industry for India	31	Fat Technology and Chemistry, Recent Advances in	143
— Role of Engineers in India	61	Fellowship, UNESCO	29
— The Far Eastern Conference on Forestry and Timber Utilization	101	—, U.S.	30
— Indo-Pacific Fisheries Council	145	Fisheries and Timber Utilisation, Far-Eastern Conference on (Edtl.)	101
— The Egerton Committee Report	191	Fisheries—Indo-Pacific Council (Edtl.)	145
— Food Self-sufficiency by 1951	229	Fishery Research	141
— Role of Science in National Reconstruction	269	Flame Spectrum of Potassium Salts	168
		Floral Year, The (Rev.)	390
		Food Self-Sufficiency (Edtl.)	229
		— Stuffs for Animal Establishments	318
		Forestry and Timber Utilization—Far-Eastern Conference (Edtl.)	101
		Forests and Infra-red Photography	95
		Forest Utilisation—Central Advisory Board	460
		Frontiers in Chemistry, Vol. VII—High Molecular Weight Compounds (Rev.)	309

	PAGE		PAGE
Friedal-Crafts Acetylation of Methyl β -Resorcyate: A New and Convenient Synthesis of 2-acetylresorcinol ..	442	Halides, Hydrogen and Alkali, Bond Energy and Ionic Character of ..	131
Frontiers in Chemistry Vol. VII—Recent Advances in Analytical Chemistry (Rev.) ..	309	— — —, Ionic Character of ..	131
Formaldehyde, Condensation Product of, with, Sulphathiazole—Assignment of Chemical Structure ..	441	Handloom Weaving Industry in India (Rev.) ..	223
Fugitive Molecules (Rev.) ..	57	Harmonic Analysis and Experimental data ..	119
Fungi Inside Rice Kernels ..	442	Harpacticoid Copepod, <i>Macrosetella Gracilis</i> (Dana), Development of ..	78
Funnel Cloud—Life-history of Typical ..	368	Heat-treatment of Silico Manganese Spring Steels ..	195
Fungi and Plant Diseases (Rev.) ..	455	Helminthology, Indian Journal of ..	111
GEODETIC Work, Part III, Survey of India Technical Report, 1947 (Rev.) ..	186	<i>Hemionitis ariofolia</i> Sm., Prothallus of ..	349
Geological, Mining and Metallurgical Society of India ..	363	Heteroecism of <i>Puccinia versicolor</i> , Preliminary Note on ..	252
-- Survey, Director of ..	226	<i>Hibiscus esculentus</i> Linn. (Lady's Finger) Colour Inheritance of Petal-base ..	212
Geology and Mineral Resources, Report of the Proceedings of the Specialist Conference, September 1948 (Rev.) ..	264	High Altitude Research Station ..	266
Geometry, Solid Analytical (Rev.) ..	334	History of Science, Society for the Study of ..	7
Genetics, Dietary of (Rev.) ..	139	Himalayas, Meteorological Mission to ..	59
Geographical Investigation of Gokulpur Lake ..	437	Honey Hunting ..	240
Geophysics, Report of the Planning Committee (Rev.) ..	224	Hormone Induced Set and Parthenocarp in Mango (<i>Mangifera indica</i> L.) ..	409
Geomagnetic Equator ..	121	Hornell, James (<i>Obituary</i>) ..	118
German Publications ..	29	Horticulture, Growth Substances and their Practical Importance (Rev.) ..	262
Germination of Double Grained Paddy in Relation to the Anatomy of Lemma and Palea ..	401	Housing of Scientific and Technical Societies in Calcutta ..	266
Gestation in Oriental Vampires ..	307	Howard Medal, 1948 ..	144
Ghee, Production and Marketing of ..	188	Human Ancestry from a Genetical Point of View (Rev.) ..	314
Glasgow Engineering Exhibition ..	268	Hyaline Trabecular cells, Occurrence of, in Mesophyll of <i>Derris Bentharii</i> ..	260
Glass—Methyl Methacrylate Glass ..	436	Hybridization between the Sugarcane and the Bamboo—(Sequel) ..	258
Glucose as a Beverage ..	8	Hybrid of <i>Pennisetum typhoides</i> Stapf, and Hubbard \times <i>P. purpureum</i> Schumacher ..	15
Glycerides, Determination of Linoleic Acid in ..	8	Hydro-Aromatic Ketazines, Criss-Cross Addition to ..	297
Glycerine Vaccine Lymph (Calf-lymph), Effect of Streptomycin on ..	406	— Electric Development (Rev.) ..	26
Goonch <i>Bagarius bagarius</i> (Ham.), Food of ..	134	— Reduction of Nitro Group to Amino Group in Alkaline Medium ..	73
Gokulpur Lake—Geographical Investigation of ..	437	Hydrolysates, Protein, for the Microbiological Assay of Amino Acids ..	427
Grain, Storing and Drying (Rev.) ..	140	Hydroxy-Carboxylic Acids, Influence of, on Reaction between α -Naphthylamine and Dichromate, and α -Naphthylamine and Vanadate ..	52
Grants for Indian Scholars ..	227	INDIA, Association of Scientific Workers ..	59
Grants for Post-Graduate Research to Indians ..	363	—, Atomic Energy Commission ..	59
— to British Universities ..	97	—, Co-ordination of Plant-Protection Work ..	60
Grasslands of Latin America (Rev.) ..	56	—, Entomological Society of ..	97
Grass Spikelets, Proliferation of ..	414	Indian Academy of Sciences ..	459
Grignard Compounds, A Study of the Influence of Impurities in the Solvent on Induction Periods and Rate of Formation of (Rev.) ..	391	— Association for the Cultivation of Science—Report for 1947-48 (Rev.) ..	92
Growth-Promoting Potency of Neera (unfermented juice) and Toddu (fermented beer) from <i>Phoenix sylvestris</i> , An Estimate of ..	250	— Chemical Society, UNESCO Grant to ..	60
Growth Rings on Otoliths of the Oil Sardine, <i>Sardinella Longiceps</i> Cuv. and Val. ..	9	— Chemical Society ..	144, 282
Gur Storage, Studies on ..	127	— Council of Agricultural Research, Animal Husbandry Wing Meeting of ..	64
HAND BOOK of Precious Stones ..	24	— of British Empire Leprosy Relief Association Annual Report 1947 ..	67
Haffkine Institute of Preventive Medicine, Bombay ..	111	— Dairy Research Institute ..	274
		— Institute of Chemical Engineers ..	29
		— of Science and Egerton Committee Report ..	231

	PAGE		PAGE
Indian Journal of Helminthology ..	111	Leprosy Relief Association, The Indian Council of British Empire—Report for 1947 ..	67
— Mathematical Society ..	459	Library Service, Special ..	429
— Medicinal Plants ..	362	Light Scattering in Normal Urines ..	245
— Philosophy Course at Asia Institute, New York ..	182	Library, Tippoo Sultan's, Medical Books in ..	425
— Phytopathological Society ..	29	<i>Lilium longiflorum</i> Wall., Vegetative Propagation in ..	299
— Scholars in Australia ..	394	Linoleic Acid, Determination of, in Glycerides ..	8
— Scientists to Tour Australia ..	30, 150	Lithium Fluoride, Elastic Constants of ..	336, 436
— Science Congress, Poona ..	366, 395	Lockspeiser, Sir Ben ..	97
— Society of Agricultural Statistics ..	107	Long Smut Infection, Artificial, of Sorghum ..	418
— Standards Institution ..	227	<i>Luffa echinata</i> Roxb. and <i>Luffa graveolens</i> Roxb., Examination of the Seed of ..	451
— Central Cotton Committee ..	450	<i>Luffa echinata</i> Roxb. and <i>Luffa echinata</i> Roxb. Examination of the Seeds of ..	451
— Indicators in Cerimetry ..	363	MACROSETELLA <i>gracilis</i> (Dana), Harpacticoid Copepod, Development of ..	78
Indo-Pacific Fisheries Council (Edtl.) ..	145	Manganese Halides, Emission Spectra of ..	245
Industrial Furnaces, Waste Heat Recovery in (Rev.) ..	86	<i>Mangifera indica</i> L.—Hormone Induced Set and Parthenocarp in Mango ..	409
— Hygiene and Toxicology (Rev.) Vol. I ..	94	<i>Macrosiphum jaceae</i> Linn. (Safflower Aphids)—History Bionomics and Control of ..	211
— — — — — Vol. II (Rev.) ..	455	Magmatic Water in Chalcedony and Agate, Bhera Ghat, Jubbalpore ..	290
Information Service, Research ..	53	Maize Oospores by <i>Sclerospora sorghi</i> ..	83
Infra-red Photography of Forests ..	95	Marine Animals, Natural History of (Rev.) ..	456
Insect Pathology, Principles of (Rev.) ..	457	Mathematics, Living (Rev.) ..	384
Insects, Need for Fundamental Research in India on ..	95	Mathematical Functions, Five Figure Tables of (Rev.) ..	263
Institute of Palæobotany, India ..	396	— Society ..	363
International Conferences ..	422	Mat-sedge, <i>Cyperus pangoeri</i> , Smut on ..	13
— Mining Congress at Oxford ..	317	Maximization of Scientific Effort (Edtl.) ..	365
— Scientific and Technical Congresses ..	319	Medical Books in Tippoo Sultan's Library ..	425
Iodobenzene, Ultra-Violet Absorption Spectrum of ..	418	Medicinal Plants, Indian ..	362
Ionic Character of Hydrogen and Alkali Halides ..	130	— — — — — Expert Committee's Recommendations ..	460
— Solids, Dielectric Constant of ..	76	Medicine—Modern—The Beginning of, in Madras ..	24
<i>Ipomœa catatas</i> (Sweet Potatoes) ..	152	Megastrobilus of <i>Nipaniuruha granthia</i> Rao A. R. ..	447
Iron and Steel, The Manufacture of (Rev.) ..	138	<i>Memecylon Heyneanum</i> Benth., Nectary in the Stamens of ..	415
ISI Quarterly Bulletin ..	95	Mesons—II and μ —Investigation of ..	120
Isotope Production ..	63	Metabolic Mechanisms of Unstriated Muscle ..	155
JACK, Sex Reversal (Heterogamy) in ..	14	Metallography, A Dictionary of (Rev.) ..	266
<i>Jatropha curcas</i> Linn.—Chemical Investigation of Seeds of ..	49	Meteorological Mission to Himalayas ..	59
Jenner, Edward (1749-1823) ..	230	— Organization, International—Asian Regional Commission ..	33
Joshi Effect, A Possible Explanation of, ..	416	Meta-Chloracetanilide, Dinitration of ..	49
Juice of Diseased Sugarcane, Observations on ..	19	Metallurgical Laboratory, Regional, for W. India ..	66
Jute Industry in Brazil ..	228	Meteorology and Hydrology, Agricultural ..	60
— Technology Institute ..	268	Mica and Shellac, ISO Committee for ..	422
KARNATIC Music, Study of Microtonal Frequency Variations ..	272	Microbiological Assay of Amino Acids, Protein Hydrolysates for ..	427
Katabatic Effect over Jodhpur ..	336	Micro-organisms in Date Palm Juice (Sendhi) ..	299
Kodurites, Apatites Gypsification in ..	169	Microbiological Assays (Rev.) ..	434
Krogh, Prof. August ..	458		
Kudzu in Mysore, Angular Leaf-Spot of ..	16		
LAC, Oxidation of, by Lead Tetraacetate ..	331		
Lady's Finger, <i>Hibiscus esculantus</i> Linn., Petal-Base Colour Inheritance in ..	253		
Lady Tata Memorial Trust ..	29, 226		
Lal C. Verman, Dr. ..	190		
Latiferous System of <i>Regnellidium diphyllum</i> Lind. ..	449		
Lead Iodide, Emission Spectrum of ..	8		
— Tetraacetate for Lac Oxidation ..	331		
Leaf-Spot of <i>Desmodium diffusum</i> Dc.— <i>Xanthomonas desmodii</i> ..	213		
— — — — — Disease of Castor (<i>Recinus Communis</i> L.) ..	210		

	PAGE		PAGE
Millerian Direct Sine Formula and the Converse Cotangent Formula ..	288	Organic Chemistry, Selected Topics from (Rev.) ..	387
Milk Purity ..	204	—, An Elementary Text-Book of (Rev.) ..	420
<i>Microbracon hebetor</i> S., and <i>Stenachroia elongata</i> H. ..	408	—, Technique of (Rev.) ..	137
Mine Surveying, A Study of (Rev.) ..	354	— Chlorine Compounds (Rev.) ..	27
Modern Physics, Foundations of (Rev.) ..	220	— Reactions, Vol. IV (Rev.) ..	89
Modulo 49— τ (n) ..	119	— Reagents used in Gravimetric and Volumetric Analysis (Rev.) ..	313
<i>Moniliformis moniliformis</i> , (Bremser, 1811), Acanthocephalia, Life-cycle of ..	216	— Remains from the Vindhyan (Pre- Cambrian) ..	438
Monobromobenzene, Spectrum of ..	437	Organolites in Industry ..	110
Monomers, Section I (Rev.) ..	385	<i>Oryza sativa</i> , Obscure Disease of Paddy, Some Observations on ..	378
Monsoon—Cultural Words of Chinese Origin ..	347	Oscillations of the Earth's Atmosphere ..	398
M.Sc. Degree Award ..	392	Ostrofsky's Formulæ, Note on a Correc- tion by Laporte to ..	435
Mrigal, <i>Cirrhina mrigala</i> (Hamilton), Occurrence in the River Godavari ..	11	Ostariophysi, The Sensory Line System and the Canal Bones in the Head of Some (Rev.) ..	455
Mukherjee, Dr. J. N. ..	307	Oxford Professorship for Eastern Re- ligions ..	143
Multiplet Spectra—A New Sum Rule for ..	333	PACIFIC Science Congress, Seventh ..	96
Muscle, Unstriated, Metabolic Mechanisms in ..	155	Paddy, An Obscure Disease of,— <i>Oryza sativa</i> : Some Observations ..	378
Music, The Physics of (Rev.) ..	24	Palæobotany, Institute of, India ..	396
Mutant of <i>Cedrus deodara</i> Loudon ..	12	Paludrine (Proguanil) Preparation of ..	77
Mutation in <i>Brassica campestris</i> Linn. var. <i>sarson</i> Prain ..	253	<i>p</i> -Aminosalicylic Acid, New Synthesis of ..	75
— Simultaneous, of Two Independent Genes in Chilli (<i>Capsicum annuum</i> L.) ..	171	(Pantothenic Acid Deficiency) Acetyla- tion in the Laboratory Diagnosis of "Burning Feet Syndrome" ..	367
NATIONAL Institute of Sciences of India ..	190	PASB Hospital Section ..	392
National Nutrition Association of India ..	392	Pasteur Institute, Gift from CCRU ..	96
— Physical Laboratory, England: New Director of ..	318	Patent System and the Scientist ..	69
— Reconstruction, Role of Science in (Edtl.) ..	269	<i>p</i> -Cymene from Carene ..	205
Natural Gas at Jawalamukhi Mandir ..	244	—: Important Reactions and Some Methods of Purification ..	315
— History, Field Book of (Rev.) ..	310	Penicillin, Effect of, on Bacterial Conta- minants of Vaccine Lymph (Calf lymph) ..	373
Nature—Conservation and National Parks ..	279	<i>Pennisetum polystachyum</i> Schult, Spike- let Proliferation in ..	301
Necrosis in Tomato (<i>Lycopersicum escu- lentum</i> , Mill) ..	411	<i>Periplaneta Americana</i> L., An Egg Para- site of: Some Observations on the Bio- logy of <i>Tetrastichus hagenowii</i> Ratz. ..	407
Nectary in the Stamens of <i>Memecylon Heyneanum</i> Benth. ..	415	Pest Infestation Research (DSIR, England) (Rev.) ..	360
<i>Neera</i> (Unfermented Juice) and <i>Toddy</i> (Fermented Beer) from <i>Phoenix sylves- tris</i> : Over-all Growth-promoting Po- tency ..	250	Phanerogamic Parasite of Sugarcane and Jowar ..	342
Neon lamps, Photosensitivity of, and their Use in Cosmic Ray Circuits ..	400	pH of <i>Clostridium lacto-acetophilum</i> ..	177
<i>Nira</i> , Cholera Through ..	9	<i>Phaseolus mungo</i> , New Synchronism on ..	171
Nitro Group to Amino Group, Reduction of, by 'Hydro' in Alkaline Medium ..	73	Phosphorus Oxychloride: New Condensing Agent for Chalkone Formation ..	134
Nobel Awards for Physics, Chemistry and Medicine, 1949 ..	395	Phosphorylase, Influence of Vitamin C on ..	440
Nor'westers in Bengal ..	5	Photographic Plate, Action on Wood of ..	284
<i>Nostochoopsis</i> from Mysore ..	259	Photography in Crime Detection (Rev.) ..	221
Nuclear Magnetic Resonance and the Effect of the Methods of Observation ..	203	Photoperiodic Response in Some X-ray Mutant Wheats ..	413
— Theory and its History (Rev.) ..	23	Photoperiodism and Vernalization (Rev.) ..	27
Number Theory, Some Conjectures in ..	241	Photosensitivity of Neon Lamps and Their Use in Cosmic Ray Circuits ..	400
Nutrition, National, Association of India ..	392	Photosynthesis: Relative Effects of CO ₂ , Temperature and Light Intensity ..	241
OBSERVATORY, South Seas ..	426	Physical Chemistry (Rev.) ..	454
Oceanic Birds of South America (Rev.) ..	20	— of Process Metallurgy (Rev.) ..	311
Oil Sardine, Growth Rings on the Otoliths of ..	9	Physical Science, Fundamentals of (Rev.) ..	136
<i>Olea Glandulifera</i> , Exudation of, Occur- rence of D-Mannitol in ..	404		
Oospores Production by <i>Sclerospora sor- ghi</i> on Maize ..	83		

	PAGE		PAGE
Physics, Introduction to (Rev.) ..	353	RADIOACTIVE Isotopes for Hospitals and Medical Centres ..	421
—, Modern Text-Book of, Intermediate (Rev.) ..	419	— Mineral Deposits, A Prospectors' Handbook (Rev.) ..	265
Physical Chemistry, Outlines of ..	136	Radio Waves, Terrestrial (Rev.) ..	419
Physics of Music, The (Rev.) ..	24	Raingauges Distribution in Damodar River Catchment ..	148
Physiology, Annual Review of—Vol. XI (Rev.) ..	386	Rajasthan Academy of Sciences ..	460
—, Place Among the Sciences and Importance of Its Study ..	117	Rain of Prawns in Siam ..	302
Phytopathological Society, Indian ..	29	Raman Spectrum of Cadinenic Sesquiterpene ..	287
II and μ Mensons, Investigation of ..	120	— — Crystals and Their Interpretation ..	3
Plant Protection Work—India—Co-ordination of ..	60	— — — Methyl Methacrylate Glass ..	436
— Diseases, Soil-Borne,—Control of ..	114	Raman, Sir C. V. ..	38
Plastics—Light Scattering of ..	286	Ramunni Menon, Sir R. K. (Obituary) ..	7.
Pleochroic Halo from Granite (Chota Nagpur) ..	42	<i>Rana tigrina</i> (Daud),—A Peculiar Case of Venous Abnormality ..	345
Plough,—New—For Indian Cultivators ..	180	Rare Earths: Separation of Tetravalent Cerium from Thorium, and Other Trivalent Elements of the Group, using Potassium Periodate ..	248
Plutonium ..	143	Real Projective Plane, The (Rev.) ..	384
Polyhydroxy Aromatic Acid Esterification: Modified Method ..	218	Refractories, Draft Indian Standards for ..	28
Polymerisation: Initiation by Potassium Persulphate ..	206	<i>Regnellidium diphyllum</i> Lind., Latiferous System of ..	449
Potassium Periodate—Use in the Separation of Tetravalent Cerium from Thorium and Other Trivalent Rare Earths ..	248	Research Club ..	267
Potassium Salts, Flame Spectrum of ..	168	— Degree Award ..	226
— Persulphate as Initiator of Polymerisation in Solution ..	206	— — — Andhra University ..	318
Potato Research—Central Institute ..	362	— — — in Chemistry ..	363
Power Function of the Test for the Compatibility of an Assigned Discriminant Function ..	243	— in Industry (Rev.) ..	89
Practical Zoological Illustrations (Rev.) ..	93	— Information Service ..	53
Precious Stones, Handbook of (Rev.) ..	24	—, Quality in Scientific (Edtl.) ..	1
<i>Precis Orithya Swinhæi</i> L. (Fam. Nymphalidae), Feeding on <i>Striga</i> Spp. The Phanerogamic Parasite of Sugarcane and Jowar ..	342	Rhenium (Rev.) ..	184
Presumptive Test, More Rapid, for Coliform Bacteria in Water ..	343	Rinderpest Vaccines, Their Production and Use in the Field (Rev.) ..	311
Prize, Elliot, for Scientific Research ..	29	Role of Engineers in India (Edtl.) ..	61
Pro-embryo Culture in Normal Diploid Corn, Aged 3-7 Days ..	215	— — Science in National Reconstruction (Edtl.) ..	269
Prohibition and Health ..	166	Royal Institute of Science, Bombay ..	30
Proliferation of Grass Spikelets ..	414	Rural Adult Education ..	397
Proliferation of Spikelets in <i>Pennisetum polystachyum</i> Schult. ..	301	SABHESAN Prof. M. S. (Obituary) ..	370
Protein Chemistry, Advances in: Vil. III (Rev.) ..	351	<i>Saccharum</i> : Occurrence and Importance of Starch as Specific Character in ..	346
— Deficiency and Dietetic Hepatic Lesions ..	108	— <i>spontaneum</i> : Protogeny in Indian Forms ..	410
Prothallus of <i>Hemionitis arifolia</i> Sm. ..	349	— Synthesis from Anthranilic Acid ..	440
Protogeny in Indian Forms of <i>Saccharum spontaneum</i> ..	410	Safflower Aphids (<i>Macrosiphum jaceae</i> Lin.), History, Bionomics and Control of ..	211
Prunetin, Synthesis of ..	404	<i>Sagitta Bombayensis</i> Lele and Gæ—A Synonym of <i>Sagitta robusta</i> Doncaster with a Record of <i>Sagitta pulchra</i> Doncaster —From Indian Coastal Waters —	448
<i>Puccina versicolor</i> Heterœcism, Preliminary Note on ..	252	Sahni, Professor Birbal (Obituary) ..	158, 199
<i>Pueraria thunbergiana</i> , Judzu Vine, Seed Setting in ..	379	"Sampling, A Certain Distribution in the Theory of" A Note on ..	374
Pulses and Transients in Communication Circuits (Rev.) ..	389	<i>Sagitta pulchra</i> , A Record of, From Indian Coastal Waters ..	448
Puranas and Archæans of S. India, Examination of Some Aspects of ..	112	<i>Sardinella Longiceps</i> Cuv. and Val., Growth Rings on the Otoliths of the Oil Sardine ..	9
QUALITY in Scientific Research (Edtl.) ..	1, 32	Scattering of Light by Plastics ..	286
Quartz Grain Orientation in Tectonites and Non-tectonites, Some Examples of ..	328	Scholarship for Indians at Colorado School of Mines ..	143
		—, 1851, Exhibition ..	7
		— Vincent Massey ..	19

	PAGE		PAGE
"Schorlite-penninite" Rock from Shimoga, Mysore	181	Stellate Discocycline from the Upper Eocene of Surat-Broach Area (Bombay Presidency)	400
<i>Schizanthus</i> Sp., A Host of Tobacco Leaf-Curl Virus	260	<i>Stenachroia elongella</i> H. and <i>Microbracon hebetor</i> S.	408
Science and Religion	154	<i>Striga</i> —Biological Control	445
— Theosophy (Rev.)	430	Streptomycin, Effect of, on Glycerine Vaccine Lymph, (Calf lymph)	405
— Congress, Indian	395	Structure—Chemical, of the Condensation Product of Formaldehyde with Sulphathiazole	441
— , Seventh Pacific	96	Stuff We're Made of, The (Rev.)	25
— , Society for the Study of the History of	7	Subba Row, Yellapada (Obituary)	70
— Stages, A Come Back to India	2	Substituted Polyguanidines, Attempt towards Synthesis of	294
Scientific Advances in World War II—Reports	99	Sugarcane, <i>Cerebella</i> on	180
— Aspects of Silk Production (Edtl.)	321	— D.D.T. as Insecticide	129
— Effort, Maximization of	365	— , Earliness Index in	172
— Liaison (Edtl.)	443	— Juice, Chemistry of, in Relation to Manufacturing Qualities: Study with Special Reference to Open Pan Industry	340
— Man-power and Fundamental Research, The Needs of, by Sir S. S. Bhatnagar	2	— Juice, Effect of Waterlogging on	443
— Regional Bibliography for S.E. Asia	370	— (Saccharum officinarum): Top Sillage as Feed for Cattle	325
Scientists and the Patent System	69	— Seedlings, Wooden Pans for	18
Screw Thread System, Unified	23	— Some Observations on the Juice of Diseased	19
Seed Setting in Kudzu Vine (<i>Pueraria Thunbergiana</i>)	379	— × Bamboo Hybrids	218
<i>Semnopithecus entellus</i> , Anatomy of (Rev.)	263	Sulphathiazole, Condensation Product of, with Formaldehyde—Assignment of Chemical Structure	441
Sex Reversal (Heterogamy) in <i>Jack</i>	14	Super-cooled Water, The Freezing of (Rev.)	262
Silk Production, Scientific Aspects of (Edtl.)	321	Sunspots and Cosmic Ray Intensity	202
Silkworm Eggs: Effect of Carbon Monoxide on Artificially Bivoltinized Eggs	323	Supersonic Flow and Shock Waves (Rev.)	135
Sines and Cosines, Table of, to Fifteen Decimal Places at Hundredth of a Degree (Rev.)	420	Surface Tension, Comparison of, by Unstable Pendant Drops, Equation for	288
Sir S. S. Bhatnagar on the Needs of Scientific Man-power and Fundamental Research	2	— , and the Spreading of Liquids (Rev.)	454
Smut on Mat-sedge, <i>Cyperus pangorei</i>	13	Surface Active Agents (Rev.)	310
Shellac and Mica, ISO Committee on	422	— Tension of Cetyl Pyridinium Bromide Solution	292
Society for the Study of the History of Science	7	Sweet Potatoes (<i>Ipomoea batatas</i>)	152
Soil Science Control Committee	267	Svalof (1886-1946), History of, and Present Problems	262
Solar Activity, Decrease in	392	Sweet Potato Wcevil— <i>Cylas Formicarius</i> F. in Bombay—Life History, Bionomics and Control of	126
"Some Aspects of Television": Summary of (Rev.)	183	Symposium III on Applied Mathematics—Elasticity	327
Spectra, Multiplet, A New Sum Rule for	334	Synchytrium on <i>Phaseolus mungo</i>	171
— Raman, of Crystals and Their Interpretation	3	Synchytrium, New, of p-Aminosalicyclic Acid	75
Special Library Service	429	— of 4-hydroxy-2-phenyl-3Acetyl quino-line	444
Spectroscopy and Combustion Theory (Rev.)	54	— of Chromones and Iso-flavones, A New Reaction for	373
Spectrum, Emission—of Lead Iodide,	8	— — Yohimbine and Related Ring Structures	374
— of Monobromo Benzene	437	Synthetic Rubbers, Modern (Rev.)	433
Sorghum, Artificial Infection of, With Long Smut	418	Systematics—Modern Trends in	39
Soil and Its Organic Matter, Cation Exchange Capacity of Different Mechanical Fractions of	375	TATA, LADY, Memorial Trust	29
Solar Spectra Obtained During V-2 Flights	362	Taurine Manufacture	406
South African Fisheries (Rev.)	457	Tablet Making (Rev.)	386
Standards, Draft, for Indian Refractories	28	Teak, Leaf-Rust <i>Telia</i> in	175
— Institution, India,	227	Technological Laboratory: Director's Annual Report for '47-'48 (Rev.)	357
— — Indian, Quarterly Bulletin	95		
Starch: Occurrence and Importance as Specific Character in <i>Saccharum</i>	346		
Statistics, Agricultural, Improvement of	40		
Statistical Theory, Mathematical Procedure in	40		
Steel, Silico-Manganese, Investigation of Heat Treatment of	195		

	PAGE		PAGE
Tectonites and Non-Tectonites, Quartz Grain Orientation in	328	V-2 Solar Spectra	362
Telephone Wires, Damage to, by Carpet Beetles	35	Vegetative Propagation of <i>Lilium longiflorum</i> Wall.	299
Telia of the Leaf-Rust on Teak	175	Venous Abnormality in <i>Rana tigrina</i> (Daud.), A Peculiar Case of	345
Termites, Mound-Forming and Their Control	445	Vernalization and Photoperiodic Treatment, Effect of,—on Grain Development in Wheat	414
<i>Tetrastichus Hagenowii</i> , Ratz. Some Observations on the Biology of: An Egg Parasite of the House Cockroach (<i>Periplaneta Americana</i> , L.)	467	Vernalization and .. Photoperiodism (Rev.)	27
Theory of Groups and Its Application to Physical Problems (Rev.)	90	Viability of Immature Corn Embryos, Preliminary Investigation under Cold Storage at Freezing Point	52
Thorium, Colorimetric Detection and Estimation of	248	Vincent Massey Scholarship	19
— Periodate,—Use in Thorium Estimations	170	Vindhyan (PreCambrian), Organic Remains from	438
Thymol from Ajowan Seeds	17	<i>Viviparus dissimilis</i> (Muller), Abnormality in	84
Tick-borne Relapsing Fever in Kashmir	249	Vitamin C: New Method for Estimation	250
TiCl Band Spectrum	245	— — Influence of, on Phosphorylase	440
Titanium Oxide Band Spectrum	371	Volumetric Estimation of Silver, Barium and Strontium in Aqueous Solutions, Rapid Method for	132
γ (n) Modulo 49	119	WASTE Heat Recovery from Industrial Furnaces (Rev.)	86
Tomato Necrosis	411	Waterlogging, Effect of, on Sugarcane Juice	443
Tourmaline from Devanahalli (Mysore)	333	Wave Propelled Boats	421
Trace Elements in Food (Rev.)	183	Wheat, Effect of Vernalization and Photoperiodic Treatment on Grain Development	414
Transparent Jellies of Aluminium Molybdate, Preparation of	48	Wheat Flour, Adverse Effect of Mixing Tapioca and Sweet Potatoes with	294
Trees, Shrubs and Conifers,—Propagation of (Rev.)	356	—, X-ray Mutant, Photoperiodic Response in	413
Trips to the Moon by 1960	434	WHO Bulletin No. 2, Vol. I (Rev.)	93
Trials, Duties and Rewards	429	Western India, Regional Metallurgical Laboratory	66
Tricotyly in <i>Capsicum annuum</i> var. <i>grassa</i> Sendt.	208	Wood, Action of Photographic plate on	284
<i>Trombicula deliensis</i> , Vector of Typhus	30	Wooden Pans for Sugarcane Seedlings	18
Tuberculosis in India and Control Measures, Some Aspects of	115	Wool Research Award	392
— Chemotherapy	233	World Forestry Conference	268
Tubers in a Species of <i>Anthoceros</i>	178	— Medical Conference	226
Turions, Occurrence of, in <i>Elodea canadensis</i>	414	— Tuberculosis Conference	226
Typhus, Vector of, <i>Trombicula deliensis</i>	30	XANTHOMONAS <i>Desmodii</i> , New Bacterial Leaf-Spot of <i>Desmodium diffusum</i> Dc.	213
U.N. CONFERENCE on Resources Utilization	142	— <i>Phaseoli sojense</i> (Hedges) Dowson—A New Host— <i>Dolichos biflorus</i> L.	83
UNESCO, Book Coupons in U.S.	96	YOGA Research	268
— Booklet for Science Teachers (Rev.)	25	Yohimbine and Related Ring Structures, Synthesis of	374
— Essay Competition	97	ZERO Conductance Temperature of Some Dyestuffs	403
— Fellowship	29	Zirconium Succinate Jelly Preparation	247
— Grant to Indian Chemical Society	60	Zoological Illustrations, Practical (Rev.)	93
— Handbook of Opportunities for Study Abroad	96	— Society of India	190
Universities, British, Grant for	97	— — —, Foundation Fellows for 1949	421
Urines, Normal, Light Scattering of	245		
U.S. Research Fellowship	30		
VACCINE Lymph (Calf lymph) Bacterial Contaminants, Effect of Penicillin on	373		
Vampires, Oriental, Gestation in	307		
Vanadometry, Part I	72		
— Part II	124		
— Part III	169		
— Part IV	381		
— Part V	402		

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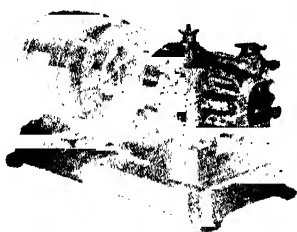
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[No. 1

	PAGE		PAGE
<i>Quality in Scientific Research</i>	1	<i>Nor'westers in Bengal.</i> S. L. MALURKAR ..	5
<i>Sir S. S. Bhatnagar on the Needs of Scientific Man-Power and Fundamental Research</i>	2	<i>Society for the Study of the History of Science</i>	7
<i>Science Stages a Come Back to India</i> ..	2	<i>1851 Exhibition Scholarship</i>	7
<i>Raman Spectra of Crystals and their Interpretation</i>	3	<i>Letters to the Editor</i>	8
<i>Preparation of Adenosine Triphosphate from Bull Frogs.</i> B. B. DEY, H. C. FRIEDMANN AND C. SIVARAMAN	4	<i>Vincent Massey Scholarship</i>	19
		<i>Reviews</i>	20
		<i>Science Notes and News</i>	28

QUALITY IN SCIENTIFIC RESEARCH

IN the course of his inspiring address to the Students and Staff of the Indian Institute of Science, Pandit Jawaharlal Nehru, Prime Minister of the Dominion of India, emphasised the need for maintaining a high standard of *quality* in the output of scientific research in this country. He deplored that the quality and output of scientific work was commensurate neither with the substantial amounts of money which were being invested on research nor with the potential talent which could be mobilised in the service of science. Except for a few brilliant examples, India's contributions to the world's scientific knowledge and technological advancement, have so far been admittedly meagre, considering the wealth of research material and human talent which are available in the country.

The first class quality of the available talent has been convincingly demonstrated by the exceptionally brilliant work which successive batches of our young men have achieved under the benign stimulus of a congenial and inspiring atmosphere which distinguishes most of the foreign centres of research. Many of these young scientists on their return to this country find themselves faced with a very discouraging "research climate" which stifles their enthusiasm and initiative, and most of them, in a couple of years, languish into scientific inactivity and are forced to adopt an uneventful and sterile career of administrative routine. Talent which should have been nurtured to its full glory and fruitfulness is thus lost to the country. Instances are not wanting to show that such

of our students who have had an opportunity of establishing a career for themselves in Europe or America, have distinguished themselves further and attained scientific eminence. The career of the late Dr. Y. Subba Row who rose to the position of the Research Director of the Lederle Laboratories, is an illustrious example of such a case. All these facts prove the contention that we, in India, have not yet established a "Research Climate" which would nurture creative talent to its full stature. The causes which have led to this

unhappy state of affairs may well be scientifically and dispassionately elucidated by a specially constituted Committee of the Association of Scientific Workers of India to whom, after all, the responsibility of creating the right type of climate for research belongs. We, therefore, urge the immediate formation of a representative committee to go into the question and suggest ways and means by which the present research atmosphere could be altered.

SIR S. S. BHATNAGAR ON THE NEEDS OF SCIENTIFIC MAN-POWER, AND FUNDAMENTAL RESEARCH

IN the course of his Presidential Address to the National Institute of Sciences of India, Sir Shanti Swarup Bhatnagar surveyed the efforts of the Government of India in the cause of scientific research and referred to the setting up of the Atomic Energy Commission, the creation of National Professorship of Physics, arrangements of visits to India by celebrated foreign scientists and the work of the Council of Scientific and Industrial Research and various other National Laboratories in existence and in formulation. He also reviewed the activities of the National Institute of Sciences during the current year.

Referring to the appointment by the Government of the Universities Commission to inquire into and report on the conditions and prospects of University education and advanced research in India and to recommend a constructive policy in relation to their special problems and the needs of the country, he said.

"The development of science and industry in this country will need a large potential scientific man-power. While national laboratories and research institutes will play an ever-increasing part in furthering the application of science to industry, it is clear that ultimately we have to depend upon the Universities for an even and constant flow of scientific workers and leaders, imbued with zeal and zest for research.

"The fast changing world conditions and the new role of science necessitate a vital change in the outlook of the Universities and the Government.

"Universities have been rightly regarded as the fountain-head of knowledge and it is in their free atmosphere that we should look forward to vigorous pursuit of fundamental research. Fundamental research is the source from which extraordinary applications are likely to emerge and unless we keep ourselves in the forefront of fundamental work it is unlikely that we would make much original contribution to applied research. I would make a special plea to our Universities, our research institutes and our learned societies not to slacken their support for fundamental research."

He put in a strong plea for sufficient financial and material resources, appropriate to each stage of development and stressed the necessity of bold and flexible thinking in framing the policy of the Universities. While industrial research was the prime necessity for development, a vigorous pursuit of fundamental research was vital, being the source from which extraordinary applications were likely to emerge, he said. It was necessary for young men to follow in the wake of great scientists and blaze the path of the better world of tomorrow.

SCIENCE STAGES A COME BACK TO INDIA

IN a gracious message to the 36th session of the Indian Science Congress held at Allahabad during the first week of January 1949, His Excellency Sri Rajagopalachari, the Governor-General of India, said:—

"Science went out for a long journey from India some centuries ago and it looks as if

she has come back to her home now. May the session of the Science Congress at Allahabad be an auspicious festival of this return home. The future progress of science in India seems fairly assured if we could appraise it on the quality and industry shown by present-day doctors of science."

RAMAN SPECTRA OF CRYSTALS AND THEIR INTERPRETATION*

ITS universal applicability, simplicity of technique, precision of results obtained and ease of interpretation make the Raman effect a powerful tool for the study of the structure of matter. The information yielded by Raman spectra has been of great value in the investigations of relatively simple molecules as well as of the more complicated polyatomic ones. Its utility in the investigations of the physico-chemical problems set by the crystalline state of matter is equally great. Although numerous papers have appeared on the Raman spectra of crystals since the discovery of the effect, very little progress was made till 1943 in using Raman effect data for the elucidation of the physical properties of solids. This state of affairs may be attributed to the fact that the physics of the solid state was dominated for many years by theories which had their birth before the discovery of the Raman effect. The reference here is to the well-known theories of solid behaviour originally put forward about the same time by Debye and by Max Born.

It is a significant fact that, subject to some noteworthy qualifications and exceptions, the modes of atomic vibration appearing in the Raman spectra of crystals are represented by sharp lines irrespective of the nature of the substance, or of the frequency of the vibrations. Basing himself on this and similar optical effects observed in crystals, e.g., luminescence and absorption spectra at low temperatures, Sir C. V. Raman (1943) formulated a new theory of lattice dynamics. The new theory leads among other things to the most important result, namely the vibration spectrum of a crystal consists essentially of a finite number of discrete frequencies. On the basis of the Raman theory, crystal lattice has in general $(24p-3)$ modes of normal vibration (excluding simple translations) in $(3p-3)$ of which all the units in the structure have the same phases, while in the remainder equivalent atoms in neighbouring cells along one, two or all three primitive translations vibrate with opposite phases. The experimental confirmation of this prediction became a matter of fundamental importance for the progress of crystal physics. As the available data on the Raman spectra of crystals were insufficient, it became necessary to carry out a series of investigations using an improved experimental technique to give a decisive answer to the following issues raised by the new lattice dynamics: (1) Are the vibrations in crystals which manifest themselves in the Raman spectrum, waves extending through the volume of the crystal, or are they the vibrations of the atoms in the individual cells of the lattice? (2) Is the complete vibration spectrum of the crystal in the infra-red region a continuous diffuse spectrum, or is it a discrete spectrum exhibiting a finite set of monochromatic frequencies?

It has been the practice generally to use the λ 4046 and λ 4358 radiations of the mercury arc as exciter in the studies on the Raman spectra of crystals. The Raman lines excited by these radiations fall in the very region where the weak fluorescence exhibited by many crystals appear and where the spectrum of the mercury arc itself shows a weak continuum. Consequently feeble Raman lines may not be detected as they will appear overpowered by the continuum. In view of these difficulties, the technique of using the λ 4046 and λ 4358 radiations for the study of the Raman effect in crystals appeared to have already been pushed to the limit of its utility during recent years. It became clear that some radical improvement in the technique of study had to be effected in order to get further useful information about the Raman spectra of crystals. This was achieved by the so-called ultra-violet technique described below.

As is well-known, it is essential to employ a monochromatic light source which is very intense for recording the extremely feeble Raman scattering in crystals. It is also of great importance that there should be no continuous spectrum accompanying the same. This is secured by using the λ 2533.5 mercury resonance radiation from a water-cooled magnet-controlled quartz arc. The enormously increased scattering power of the resonance radiation arising from its exceptional intensity as compared with the other mercury radiations and from the λ^{-4} law has made it an ideal source for Raman effect studies in the case of crystals that are transparent to the ultra-violet and do not get coloured by prolonged exposure to this radiation. The λ 2533.5 radiation from the light scattered by the medium is effectively suppressed before its entry into the spectrograph by absorption in a column of mercury vapour, as otherwise the photographic plate would be fogged. This makes it possible to record faint Raman lines with small frequency shifts on a clear background.

Using the improved experimental technique for exciting the Raman spectra, many crystals have been studied by Dr. R. S. Krishnan during the last five years and a rich harvest of results obtained in every one of the cases investigated. The results obtained in the case of diamond, rocksalt, potassium bromide, ammonium chloride and ammonium bromide afford a direct experimental verification of the predictions of the new theory of crystal dynamics. In all these cases, the second order Raman spectra exhibit a series of sharply defined frequency shifts. The numerical evaluation of the eigen frequencies for the above crystals on the basis of the new lattice dynamics leads to results in good agreement with observational data. Their activities in light-scattering and in infra-red absorption are also in accordance with the theoretical predictions.

From the experimental facts presented herein on the Raman spectra of crystals, it is clear that the parts of the vibration spectrum in the lower and upper ranges of frequency differ radically in their behaviour. The first part is totally inactive in light scattering,

*Abstract of the Presidential Address delivered by Prof. R. S. Krishnan, D.Sc., Ph.D. (Cantab.), F.A.Sc., to the Physics Section of the Indian Science Congress, Allahabad, 1949.

while the second part is strongly Raman active giving an intense second order spectrum. The character of the spectrum is also totally different in the two ranges of frequency. While the spectrum of the elastic vibrations is necessarily a continuous one, the discrete nature of the atomic vibration spectrum in the upper ranges of frequency is clearly manifested in the second order Raman effect; overtones and summations of the primary vibration frequencies appear under adequate instrumental power clearly resolved into numerous closely spaced sharp lines. These differences are fundamental and will compel anyone to recognise that the two parts of the vibration spectrum are physically different. In the

lower ranges of frequency, we are concerned with elastic waves traversing the crystal from end to end and forming stationary wave-patterns, while in the upper ranges of frequency, we are concerned with the vibrations of the atoms in the individual cells of the crystal lattice. The spectroscopic facts thus give a decisive answer to the theoretical issues stated at the end of the second paragraph. They show that the assumptions on which the Debye and Born-Karmann theories are based are unjustified and that the conclusions regarding the nature of the atomic vibration spectra to which those theories lead are altogether untenable.

PREPARATION OF ADENOSINE TRIPHOSPHATE FROM BULL FROGS

B. B. DEY, H. C. FRIEDMANN AND C. SIVARAMAN

(Bio-Chemical Laboratory, University of Madras)

IT has been known for some time that the phosphorylation of glucose by means of adenosine triphosphate (A.T.P.)—or adenylyl pyrophosphate, as it is sometimes called—under the influence of the so-called "Hexokinase", an enzyme found in yeast by Meyerhof,¹ and the occurrence of which has also been recently demonstrated in animal tissues,^{2,3} plays an all-important role in the carbohydrate metabolism of animals. The reaction has assumed added importance and interest in the light of the new theory of Dixon and Needham⁴ of the action of vesicant poison gases and of the observations made recently by Price, Cori and Colowick⁵ and by Colowick, Cori and Slein⁶ that the activity of animal hexokinase is inhibited *in vitro* by certain extracts of the anterior pituitary gland; and that this inhibition is counteracted again by the pancreatic hormone, Insulin. Fresh light appears thus to be thrown on the mechanism of the long known antagonism between certain hormones, that in the present case being correlated with the activities of a particular enzyme system in the body.

The adenosine triphosphate required for some of the preliminary investigations carried out in this laboratory was prepared from the thigh and hind leg muscles of frogs by a slight modification of the original method due to Lohmann.⁷ The process would appear to be both simple and efficient when compared with that described recently by Dounce, *et al.*,⁸ using rabbit muscles. There is no reflex action causing twitching of the frog muscles and the consequent fear of possible loss of A.T.P., when the brains of the animals are pithed under the conditions described below, thus dispensing with the necessity for the use of anaesthetics like Nembutal. The complicated procedure involved in the removal of stable organic phosphates which appear to be present only in traces in frog muscles as compared with the rather large amounts found in rabbits, and of inorganic phosphates, by means of alternate precipitations with mercuric nitrate in addition to barium acetate, is also found unnecessary. The preparation can be conveniently completed in 3-4 hours as compared

to 2-3 days' intermittent work, described by Dounce, *et al.*⁸ The experimental details under Indian conditions, are recorded here as they might be of interest to other workers in the field.

The bull frogs obtained locally weighed on the average 150 grams each. They were kept under ice and salt for about five minutes and when benumbed, taken out of the bath, stretched on a board and their brains pithed or smashed with a light blow from a hammer. The legs were then held by an assistant and the muscles rapidly excised using scalpels and scissors, the whole operation with a single frog lasting 1 to 1½ minutes. The muscles were placed immediately in a weighed flask immersed in a freezing mixture, the muscles quickly weighed and then passed through a "Latapie" mincer which had been cooled previously in ice. Approximately 100 grams of minced muscles were obtained from three bull frogs. The mince was allowed to fall directly into ice-cold 10 per cent. trichloroacetic acid (100 ml.) in an Erlenmeyer flask, shaken up repeatedly by taking out of the freezing bath for a few seconds at a time, and filtered through cloth at the pump into an ice-cooled receiver, after a few minutes. The residue was extracted once again with 4 per cent. trichloroacetic acid (100 ml.) in the same way and filtered. The total extract (225 ml. approx.) was centrifuged in the cold to free from precipitated proteins, the clear liquid treated with ice-cold $N NaOH$ until only just acidic to Congo Red (50 ml. approx.) and then an equal volume of ice-cold alcohol (approx. 95%) was added. A slight precipitate, which separated after standing for a short time and which consisted mainly of glycogen,⁷ was centrifuged off. To the clear ice-cold alcoholic solution (50 ml. approx.) which still tested acidic to Congo Red, was added slowly from a burette a cold 2½% solution of barium acetate until the solution ceased to be acidic to Congo Red (8 ml. approx.). The precipitate, which is the di-barium salt of A.T.P. together with some inorganic barium phosphate, was separated at the centrifuge and then shaken up with ice-cold water (75 ml. approx.) and

the precipitate dissolved by the addition of a small amount of cold N HCl , about 6 ml. being found sufficient. A small amount of insoluble material was removed by centrifuging. To remove inorganic phosphates, the barium salt was again precipitated as described before by adding an equal volume of alcohol (75 ml. approx.) and then 25% barium acetate solution until the suspension was just alkaline to Congo Red, centrifuged and the dissolution, precipitation and centrifuging repeated two more times. Each dissolution required less HCl than the previous one, and more and more of the nucleotide salt was precipitated by alcohol each time. For the last precipitation no barium acetate or at most one drop was required to render alkaline to Congo Red. This is due to the formation of a mixture of the mono and the di-barium salts of A.T.P., of which the former is soluble and the latter insoluble in water. It also explains the rather high phosphorus and nitrogen percentages of the product. The product is finally centrifuged, washed with alcohol of increasing strength and then with ether and dried *in vacuo* over sulphuric acid, at room temperature. 286 milligrams of a product containing only traces of inorganic phosphate were obtained from 3 bullfrogs yielding 10 grams of muscle. The purity of the product was determined by estimating the ratio of labile or hydrolysable phosphate by hydrolysis with N HCl on boiling water-bath for 7 minutes—to stable phosphate by the method of Fiske and Subbarow,¹⁰ and also the total nitrogen. The data obtained from the analyses of two of the preparations are given below:—

Prep. i. 572 mg. Ba-salt were obtained from 202 grams of muscle derived from 6 bullfrogs.

Total phosphate	.. 11.58%
Hydrolysable phosphate	.. 7.83%
Hence, hydrolysable P : stable P ::	7.83 : 3.75, i.e., 2.09 : 1 (Theory, 2 : 1).
Nitrogen	.. 8.91%

Prep. 2. Similar yield.

Total phosphate	.. 11.36%
Hydrolysable phosphate	.. 7.49%
Hence, hydrolysable P : stable P ::	1.94 : 1. (Theory, 2 : 1).
Nitrogen	.. 8.77%
$\text{C}_{10}\text{H}_{14}\text{O}_{13}\text{N}_5\text{P}_3\text{Ba}_4\text{H}_2\text{O}$	.. 9.8%
requires N	.. 9.8%
$\text{C}_{10}\text{H}_{12}\text{O}_{13}\text{N}_5\text{P}_3\text{Ba}_2\text{H}_2\text{O}$	.. 8.2%
requires N	.. 8.2%

In all preparations, inorganic phosphate directly estimated was negligible.

The sodium salt of A.T.P. was readily prepared from the barium salt by removing the barium directly with the calculated amount of N sulphuric acid, neutralising with N NaOH to pH 7.0 and centrifuging off the precipitated barium sulphate; as little as 1 ml. of solution can thus be prepared in 15 ml. graduated centrifuge tubes. For such small volumes a loss of A.T.P. due to adsorption on the barium sulphate¹¹ is unavoidable. The A.T.P. content of the solution is determined by estimation of the total phosphate. The salt is stored as barium salt in desiccator and solutions are prepared just before use. The compound appears most stable as sodium salt, stored in solution (pH 6.8) at -12°C .

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NOR'WESTERS IN BENGAL

S. L. MALURKAR

(Colaba Observatory, Bombay)

THE arguments and the results from a study of winter rain in the U.P. are applicable to a study of nor'westers in Bengal. Bengal is a densely populated part of India where flat bottomed river craft form a chief mode of transport. The nor'westers cause damage to these river craft and sometimes cause loss of life.

Intensive meteorological observations have been taken in Bengal to study the nor'westers. Many workers have studied the various aspects of the phenomenon.² Quoting from Prananik "Nor'westers or Kalbaisakhi (calamities of the month of Baisakh) are severe thunderstorms which occur in Bengal during the summer months March to May, some of which reach Tordanic violence and cause considerable damage to property and sometimes even loss of life. The winds in these thunderstorms come generally from some north-

westerly direction and hence they are called nor'westers. In some cases, funnel-shaped clouds characteristic of tornadoes have been noticed..... It is generally agreed that the nor'westers are not 'local heat' thunderstorms. This appears to have been recognised by Eliot as early as 1876. They also do not occur when the whole of north-east India is over-run by one air mass, i.e., during winter when west to north-west winds prevail and during the periods of strong monsoon when moist winds from the Bay prevail. They occur mostly during the transition period from the winter season to the rainy season, i.e., when two different air-masses, west to north-west winds of land origin and moist winds from the Bay co-exist over Bengal".

Eliot brought in the idea of a cold wedge. M. G. Subramanyam used to say that though there was a southerly feed in the lower levels

of upper air, there would be no nor'wester unless a low pressure wave (shown by the movement of a negative pressure change or negative pressure departure or an actual low pressure area) passed over Bengal. Sohoni found that nor'westers occurred mainly when there was a passage of depression or low pressure wave from the west towards N.E. India and there was a west to east pressure gradient over Bengal. Sen suggested that cold wedges of air from Assam coming down the valleys and undercutting the warm moist winds from the Bay of Bengal gave the nor'westers. Ramanathan used to talk of an incursion of Chinese or Mongolian air but to the author's knowledge did not further pursue the problem. Chatterjee and Sur tried explaining the inversions over lower Bengal in April and May as similar in type to those first observed by J. H. Field over Karachi in August and September 1905. The inversion over Karachi was, they said, due to the same cause, but the history of the dry air over-running the moist air over Karachi was different from that of the dry air over Bengal. They also said that one nor'wester may act as a 'trigger' for a neighbouring one.

The actual method, the writer used in the course of his routine work was based on the analysis of the western disturbance into a number of secondary low pressure areas. When any of these low pressure areas were expected to cross Bengal or its longitude, and when sharp wedges³ of high pressure formed whose tips were directed in some westerly or southerly direction the situation was watched as being favourable for the production of nor'westers.

Most of the workers are convinced about a shallow layer of southerly feed from the Bay of Bengal, and about the eastward passage of a low pressure wave. Both these are satisfied if a split up low pressure area of a western disturbance (as analysed above) is passing over Bengal. The secondary is situated in about the latitude of 25° N. The effect of it on upper air circulation would be confined to about 2 or 3 kms, and this would give the "shallow" moist feed. Above the height of 2 or 3 km., as before, the circulation is determined by the rear of a more northerly secondary low pressure area of the western disturbance. Colder air than what was existing previously at those levels must be flowing at those higher levels. When the 'cold front' of the secondary low pressure area reaches the given locality, both the favourable conditions and an initial cause of convection are present as in the U.P. and thunderstorms should occur if no other circumstance intervened. This extraneous circumstance is due to the temperature inversion which persists all the time in the pre-monsoon months and gets broken only during the thunderstorms.

The southerly feed is from the sea and is naturally more moist than the corresponding feed in the U.P. The air can generally be classed as tropical Maritime air (Tm). It undergoes latitudinal convergence and should produce rain easily if other circumstances like temperature inversion did not stand in the way.

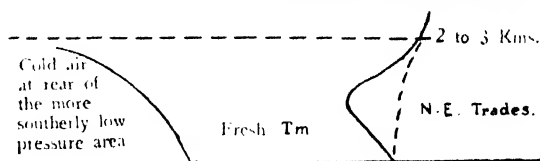
The Tropical Maritime air may also get sometimes mixed up with Equatorial Maritime air (Em). The Em which would have come from the other side of the equator, would be very moist and could be made easily unstable. Tm may also be fed by the bent back 'N.E. Trades' (Tr) which in the premonsoon months would be over Bengal. The situation would then resemble wet western disturbances⁴.

The role of tropical continental air over Bengal is similar to that in the U.P. At the higher level the rear of the more northerly secondary low pressure areas determine the circulation and the air is Tc. After the passage of the 'cold front' at the lower levels or the surface over a locality, the air even at lower level is Tc and hence homogeneous with the air above 2 km. It is quite explicable how if one depended on only available observational material, confusion could arise that the downward squall of one nor'wester acted as a 'trigger' for the next nor'wester in the neighbourhood.

Regarding the temperature inversion.—The temperature inversions at Karachi occur later in the year (June onwards). In between Karachi and south Bengal there is hardly any inversion. The 'N.E. Trades' are winds that have an equatorward motion and hence undergo latitudinal divergence, and exhibit temperature inversions. In the pre-monsoon months the N.E. Trades get displaced to South Bengal. The N.E. Trades may not be as hot and moist during the pre-monsoon months as in the monsoon. When the low pressure areas of a western disturbance moves eastwards, the N.E. Trades or Tr get an eastward displacement and at the same time Tr bends back to feed into the low pressure area. The bending back may be indicated by the high pressure wedges directed to west or south. The eastward displacement and bending back of Tr together, under the influence of a low pressure area, are sufficient to dynamically explain the disappearance of the temperature inversion over a locality.

Figure below is a vertical structure before the onset of a nor'wester. The receding Tr is shown by the dotted line (at the time of nor'wester).

Fresh Cold Air at the rear of a Northern Low Pressure Area of a Western Disturbance



Though the favourable conditions like fresh Tm at lower levels and fresh Tc at higher levels are present over a locality in Bengal, due to temperature inversion, and lack of marked orography, thunderstorms cannot occur unless the velocity gradient at the rear of the 'cold front' is large. But the effect of the 'cold front' by itself is on an average small in Bengal. The additional cause of

vertical convection is provided by afternoon heating or insolation. For vertical convection due to strong surface heating, there must be inequality, i.e., the isopycnics must not be horizontal.⁶ The distribution of rivers and land apparently provide the necessary contrast in surface heating. The rivers may play a part in postponing the time occurrence of the nor'wester.

In the nor'westers there is an absence of uneasily recognisable time sequence. Most of the nor'westers occur in the afternoons, i.e., are dependent on the afternoon heating or insolation. The main causes are due to insufficient wind velocity gradient at the 'cold front' due to lack of mountains and other marked orographic features and due to the temperature inversion. The temperature inversion can only break up if the low pressure area is marked. The low pressure areas of the western disturbances are not quite marked over Bengal. Insolation deepens the low pressure area. Hence the tendency to wipe out the inversion over a locality would be possible in the afternoons. The large river systems tend to disturb the even movement of the nor'westers.

The temperature inversion allows sufficient energy to accumulate until the explosive condition is reached, and may be responsible for the severity of the thunderstorms.

With an extended chart, it must be possible to trace all the air masses considered above.

But with a limited chart some helpful criteria can be given. The upper winds in and

around the Bay of Bengal and the weather there should be watched. An inflex of bent back Tr to a secondary low pressure over C.P. or Orissa area⁴ moving ENE wards towards Bengal was found to pre-indicate the occurrence of nor'westers. The inflex of Tr to the low pressure area could be deduced if the winds at latitudes south of about 17° N like Port Blair veered and become SE and the winds at stations to the north of the latitudes and almost to the west of Bengal were S.W. The winds in lower Burma and Tenasserim may also be used as for Port Blair. Here again, the time between the winds at Port Blair becoming S.E. and winds along North Madras and Orissa becoming S.W. and the onset of nor'westers can be decided after statistics have been collected over a long period. 36 hours may just be the outside limit.

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SOCIETY FOR THE STUDY OF THE HISTORY OF SCIENCE

THE need of forming a national society in India for the promotion of studies in the history of sciences in this part of the world was explained by Dr. Alexander Wolsky of UNESCO at a meeting of some delegates to the Science Congress at Allahabad on 3rd January 1949.

Dr. Wolsky explained the role which the UNESCO would play in his scheme of forming a National Committee or a Society in India. He said that the role of the UNESCO would be an indirect or passive one.

Dr. Wolsky thought that India with such a glorious past in the history of science was a bit neglected and there should be more active research in this direction. The rest

of the world should know far more about the scientific achievements of this country and it was really something which should attract attention all over the world.

Dr. Wolsky pointed out that a Society formed for the purpose of study of history of sciences in this part of the world would find it easier to ask for financial support from the International Union as he was confident it would be forthcoming.

After a short discussion of Dr. Wolsky's proposal, the Science Congress formed a committee with Prof. Banerjee as convener and with powers to co-opt, to formulate a scheme in this connection.

1851 EXHIBITION SCHOLARSHIP

ONE Science Research Scholarship will be awarded this year by the Royal Commissioners for the London Exhibition of 1851 to students from Indian universities or institutions having post-graduate departments of Science. The scholarship, which is of the value of £ 350 per annum and tenable for a period of two years, is intended to enable the selected student, who has already completed a full university course and whose record gives evidence of capacity for original scientific investigation, to devote himself to post-graduate research in some branch of pure or applied Science at any

institution abroad approved by the Commissioners.

Subjects of the Dominion of India below the age of 26 on May 1, 1949, will be eligible for this Scholarship. Applications from students whether residing in India or abroad have to be recommended by the authorities of a university or an institution and are to be made to Provincial Governments and local administrations through the universities and institutions concerned who would forward them so as to reach the Secretary, Ministry of Education, Government of India, not later than March 10, 1949.

LETTERS TO THE EDITOR

	PAGE		PAGE
<i>Emission Spectrum of Lead Iodide—</i>		<i>Sex Reversal (Heterogamy) in Jack-Fruit</i>	
P. TIRUVENGANNA RAO	8	<i>Tree (Artocarpus integrifolia, Linn.)—</i>	
<i>Glucose as a Beverage—F. GORDON</i>		S. V. VENKATARAYAN	14
CAWSTON	8	<i>A Note on the Amphidiploid of the Hybrid</i>	
<i>The Determination of Linoleic Acid in</i>		<i>of Pennisetum typhoides Stapf. and</i>	
<i>Glycerides—A. R. S. KARTHA, K. N. MENON</i>		<i>Hubbard × P. purpureum Schumacher—</i>	
AND P. S. RAMAN	8	N. KRISHNASWAMY AND V. S. RAMAN ..	15
<i>Cholera through Nira—J. V. BHAT AND</i>		<i>Angular Leaf-Spot of Kudzu in Mysore—</i>	
RODA N. REPORTER	9	M. J. THIRUMALACHAR	16
<i>The Growth Rings on the Otoliths of the</i>		<i>Production of Thymol from Ajowan Seeds *</i>	
<i>Oil Sardine, Sardinella longiceps Cuv.</i>		—JAMES VERGHESE, K. C. GULATI AND	
<i>and Val.—R. VELAPPAN NAIR</i>	9	M. L. JOSEPH	17
<i>On the Occurrence of the 'Mrigal' Cirrhina</i>		<i>Wooden Pans for Sugarcane Seedlings</i>	
<i>mrigala (Hamilton) in the River</i>		R. R. PANJE	18
<i>Godavari—K. H. ALIKUNHI</i>	11	<i>Some Observations on Juices of Diseased</i>	
<i>Al Mutant Cedrus Decidua, Loudon—</i>		<i>Sugarcane—K. L. KHANNA AND A. S.</i>	
T. N. KHOSHOO	12	CHACRAVARTI	19
<i>Smut on the Mat-Sedge, Cyperus pangorei,</i>			
<i>Rottb.—S. V. VENKATARAYAN</i>	13		

EMISSION SPECTRUM OF LEAD
IODIDE

CONTINUING the work on thallium iodide, the emission spectrum of the iodide of lead, the element next to thallium in the periodic table, is obtained in a high frequency discharge. Characteristic bands attributed to the diatomic molecule PbI , are obtained in the region $\lambda 6400 - \lambda 4300$. The bands are generally degraded towards the red, though some of them chiefly on the more refrangible end of the spectrum are headless and diffuse. A vibrational analysis of the bands has led to the following approximate constants.

$$\nu_e = 19509.6 \quad \omega_e' = 119.5 \quad \omega_e'' = 156.6$$

$$\chi_e' / \omega_e' = 0.25 \quad \chi_e'' / \omega_e'' = 0.30$$

The vibrational constants are found to be in keeping with those of the related iodide molecules in the same horizontal row of the periodic table and of the other halides of lead. The intensity distribution in the system is analogous to that in the emission bands of $PbCl$.

A full discussion of the analysis is being communicated shortly to the *Indian Journal of Physics*.

Andhra University, P. TIRUVENGANNA RAO.
Waltair,
December 8, 1948.

GLUCOSE AS A BEVERAGE

IN wine-growing districts there is sometimes a severe shortage of good milk and cheese except where cows are kept privately, and

excessive cultivation of grapes may interfere with adequate grazing of cattle.

Refreshing beverages are widely favoured but there is reason to object to much of the preserved mineral waters which have only partially supplied the demand for fresh-fruit juices instead of what may be kept indefinitely.

There is a common demand for some sweet beverage which may be taken repeatedly and for long periods with impunity and this is available with solutions of Glucose.

Invalids and convalescents are often recommended to take Glucose as a readily absorbed remedy for wasting disease and it should be encouraged among communities affected by malnutrition as well as to prevent acidosis.

Glucose is readily excreted by the kidneys, is a useful stimulant for persons about to undergo an operation and serves as a useful substitute for other flavouring of plain water.

If this beverage were more accessible among the poorer classes and became popular among the wealthy it would do much to supply a natural craving after sugar without producing the undesirable effects of alcoholic beverages.

Durban F. GORDON CAWSTON.
December 16, 1948.

THE DETERMINATION OF LINOLEIC
ACID IN GLYCERIDES

STAINSBY¹ has proposed a method for the determination of linoleic acid in edible fats consisting in the oxidation of the fat in

anhydrous acetone with potassium permanganate followed by titration of the acidic glycerides after removal of the volatile acidic products by distillation. Kartha and Menon,² in the course of the development of their method for glyceride estimation, considered the possibility of estimating azealo-glycerides by means of their acid values, but preferred saponification values, in order to avoid hydrolysis of azealo-glycerides during titration with alkali. Kartha and Menon have been engaged in effecting further improvements and are now engaged in work with synthetic glycerides. Although their work in this direction has not yet reached publication level, the appearance of Stainsby's paper makes it necessary to publish this note.

We have applied Stainsby's method to one of our synthetic glycerides containing oleic and linoleic acids only. It contains 39.98% of linoleic acid on the basis of iodine value, further confirmed by quantitative estimation as tetrabromide after regeneration of the free acids by hydrolysis. Three separate experiments under identical conditions gave the values 58.5%, 51.5% and 54.2% by the Stainsby method. This method has not proved satisfactory in our hands.

Kartha and Menon's distrust of acid values in glyceride estimation is being further confirmed in our laboratories. We have reasons to suspect a not negligible amount of hydrolysis of azealo-glycerides even during the course of acetone-permanganate oxidation. This difficulty can be overcome and the details of our work in all directions will constitute papers to be submitted for publication elsewhere.

Maharaja's College,
Ernakulam,
December 23, 1948.

A. R. S. KARTHA.
K. N. MENON.
P. S. RAMAN.

1. *Analyst*, 1948, **73**, 429. 2. *Proc. Ind. Acad. Sci.*, 1943 **17**, 114.

CHOLERA THROUGH NIRA

DURING the course of an investigation on the susceptibility of certain foods and drinks to contamination with and suitability for the growth and distribution of some intestinal pathogenic bacteria,^{1,2,3} it occurred to us that similar studies with regard to *nira* would be of interest and of considerable importance from the public health standpoint inasmuch as this drink is being popularized as a healthful drink for man. Accordingly *nira* was tested for its suitability for the growth and viability of *E. typhosa*, *S. paratyphi*, *S. schottmulleri*, *S. enteritidis*, *S. dysenteriae* (Shiga), *S. paradyenteriae* (Flexner), *E. coli* and *V. cholerae*.

Nira was examined in its non-sterile, steam-sterilized and filter sterilized states and the methods employed in its examination were much the same as outlined previously² with this difference that in this instance *nira* was employed in three dilutions only, viz., 33 $\frac{1}{3}$ %, 66% and in an undiluted form, and the tests for multiplication and viability were followed every half an hour instead of every three hours.

The results obtained indicate that, with the exception of the dysentery bacilli, all the other bacteria tested can not only multiply in *nira* but can actually remain viable for 1 to 3 days or longer depending on the dilution and the sterility status of the samples as well as on the nature of the inoculated species. Alcohol formation in the non-sterile samples was, however, observed to have a deleterious effect on the growth, viability, motility, antigenic character and pathogenicity of the bacteria studied. But so far as the *V. cholerae* was concerned, it was observed that in the initial stages of its growth it could even suppress the growth of the indigenous flora of *nira* and that its activity or character was not at all influenced by the production of small quantities of alcohol. In other words, there were unmistakable experimental evidences to suggest that the contamination of *nira* with the cholera vibrio would result in its multiplication with the consequence that contaminated *nira* or for that matter even *toady* (fermented *nira*) would constitute a menace from the cholera infection view-point.

A detailed report on this subject will be sent for publication elsewhere. In the meantime it must be reported here for the information of the epidemiologist that during last December twenty persons were diagnosed to be suffering from cholera as a result of drinking contaminated *nira* from a newly opened centre in Poona. It is also significant to refer here that eleven of the people taken ill had later succumbed to the infection.

Microbiology Dept.,
St. Xavier's College,
Bombay,
January 10, 1949.

J. V. BHAT.
RODA N. REPORTER.

1 Bhat, J. V., and Ragunath, M., *Curr. Sci.*, 1948, **17**, 213 and 264. 2 Bhat, J. V., and Reporter, R. N., *Curr. Sci.*, 1948, **17**, 183. 3 Reporter, R. N., "Suitability of certain foods and drinks for the growth and distribution of some intestinal pathogenic bacteria," M. Sc. Thesis Bomb. Univ., 1944.

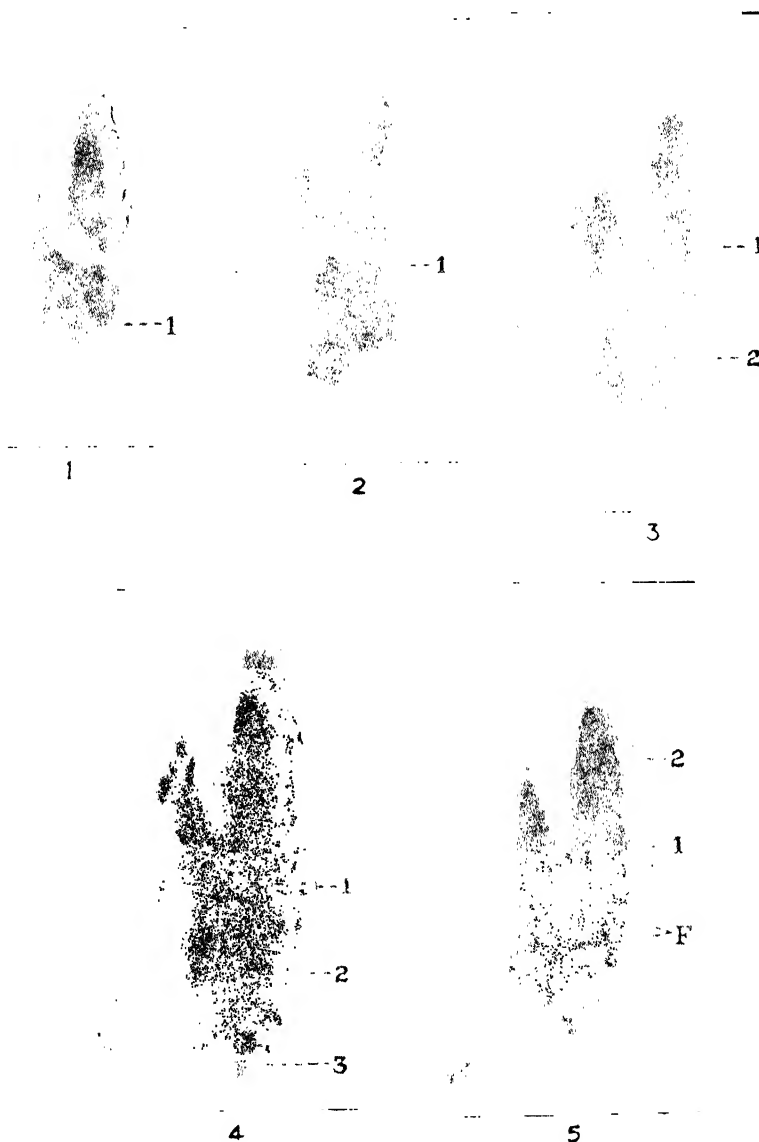
THE GROWTH RINGS ON THE OTOLITHS OF THE OIL SARDINE, *SARDINELLA LONGICEPS* CUV. AND VAL.*

THE importance of the study of growth rings on the otoliths and scales of fishes for age determination, by which alone the passage of year classes of commercially important fishes can be followed through the fishery, appears to have been well realised in European countries where intensive investigations on these structures have been made for several years. In India, however, judging by the paucity of investigations in this field, very little attention appears to have been devoted to the determination of age of even the economically more important fishes. The observations of Rao (1935) and Sastry (1936) on the otoliths of *Psettodes erumei*, of Hornell and Nayudu (1923) and Devanesan (1943) on the growth rings on the scales of *Sardinella longiceps*, and of Chacko, Zobairi and Krishnamurthi (1948).

on the radii (circuli ?) of the scales of *Hilsa ilisha* may be mentioned in this connection.

Hornell and Nayudu were the first in India to detect the presence of growth rings on the scales of the oil sardine and to conclude that

maturity and adult size of 15 cm. at the end of one year, the growth becoming extremely slow thereafter. In the course of a detailed study of the scales, Devanesin has noted the first growth ring on the scales of young oil sardines



Photomicrographs 1-5

1. Right otolith of *Sardinella longiceps* showing one growth ring. $\times 16$. (123 mm., gonads undeveloped, 25th November 1948.) 2. Right otolith of *Sardinella longiceps* showing one growth ring, and a wide second growth zone. $\times 16$. (150 mm., immature male 29th November 1948.) 3. Right otolith of *Sardinella longiceps* showing two growth rings. $\times 16$. (195 mm., female, 31st July 1948.) 4. Right otolith of *Sardinella longiceps* showing three growth rings. $\times 16$. (203 mm., male, 19th October 1948.) 5. Right otolith of *Sardinella longiceps* showing two growth rings and false rings (F). $\times 16$. (195 mm., female, 19th October 1948.)

they are formed when growth ceases with the scarcity of planktonic food, and that its longevity is limited to two and a half years. According to them the oil sardine attains sexual

of 6.5 cm. in length and six of them in fish of 8.7 cm. and suggested that nine and fourteen growth rings may be expected to be present in fishes of 15 and 18 cm. size groups respectively.

It appears probable that he has included the false rings also in his counts, which could be distinguished from the true rings by the characteristics given by Walford and Mosher (1943) for the Californian sardine, *Sardinops caerulea*. The conclusions of these authors, therefore, are so widely different that the span of life of the oil sardine, which ranks as the best known commercial fish of this country has been in doubt.

In view of the prevailing contradictory opinions on the age of the oil sardine, as judged by the study of the scales, special attention was given to the study of otoliths and scales, particularly to the former to determine their value in age determination. Contrary to the statement made by Hornell and Nayudu that "no definite lines of growth can be made out even when the otoliths are ground to thin flakes," the presence of distinct periodical growth rings has now been detected on the otoliths of the oil sardine. These rings can be made out faintly even in wet otoliths immediately after removal from the fish, but they become more pronounced after treatment in the following manner. They are subjected to upgrading in different strengths of alcohol, drying, treating with xylol and mounting in canada balsam on slides, provided with a circular piece of bristol board having two punched circular holes, in each of which an otolith is placed. It may be mentioned here that when the otoliths are in alcohol and xylol, the white opacity of the growth zones and the translucency of the growth rings respectively become more pronounced. The degree of opacity of the growth zones can be easily controlled by varying the period for which the otoliths remain in alcohol. Such preparations, when viewed under the low power of the binocular microscope with reflected light, show the growth rings as translucent dark zones concentric with the margin of the otolith, while the intervening growth zones appear opaque white. The photomicrographs of otoliths reproduced here are taken with reflected light and show clearly the first, the second and the third growth rings. Sometimes false rings also appear, but these could be easily distinguished by their line-like appearance and tendency to join a growth ring. Occasionally otoliths fail to show the growth rings for reasons not at present known. In the majority of the otolith preparations only the first and the second growth rings are seen and in a few preparations the third ring is also seen at the posterior broad end of the otolith. My study of the otoliths of the oil sardine inclines me to the view that these rings are formed annually, probably during December to April when scarcity of planktonic food has been noted by Hornell and Nayudu, and that the average life of the fish is about three years. Judging from the size of the fish, the number of growth rings and the width of the last growth zone on the otoliths, it can be stated that the size at maturity, of 15 cm., is reached when the oil sardines are about two years old.

A detailed account of these investigations will be published elsewhere.

My thanks are due to Dr. H. Srinivasa Rao and Dr. B. S. Bhimachar for their kind encouragement and discussion on the subject.

Central Marine Fisheries Research Station,
West Hill, Calicut,
December 20, 1948.

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* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Madras.

ON THE OCCURRENCE OF THE 'MRIGAL' *CIRRHINA MRIGALA* (HAMILTON) IN THE RIVER GODAVARI*

THE 'Mrigal', *Cirrhina mrigala* (Hamilton), is one of the major Indian carps that is extensively used for cultural purposes in central and northern India. According to Day¹ the 'Mrigal' is common in "Rivers and tanks in Bengal, Deccan, N.W. Province, Punjab, Sind, Cutch and Burma, growing to 3 feet in length. It is an excellent species for stocking tanks with".

When engaged on an investigational tour in Rajahmundry during December 1947, two fingerlings of *C. mrigala*,† each about 8 inches long, were collected from the river Godavari, at the Dhoulaiswaram anicut. Enquiries then made of the local fishermen indicated that the fish, which is locally called 'Yerranenu', is rather common in the river system. Since the occurrence of the 'Mrigal' in the Godavari was hitherto unknown, an attempt was made in February 1948, to check up the reported availability, and the Godavari system was surveyed from Rajahmundry to Kotipalli.‡

The fish was fairly common in the local fish markets, being caught from the river as well as the connected tank system, and was highly esteemed. Enquiries revealed that 'Yerranenu' (Red-skinned fish) has been available in the Godavari for the past several years, like Catla or Labeo. Local fishermen have seen specimens measuring 3 feet in length, but the largest specimen in the present collection is only 2 feet long. Fingerlings, 5 to 8 inches in length, were available in the Ramachandrapuram tanks and were transported to Madras for rearing. Large, oozing specimens were found commonly caught in the Rangoon nets and the larve drag nets at Bobberlanka and Kotipalli, during July 1948.

The survey thus definitely confirms the reported occurrence of *C. mrigala* in the river Godavari. The facts that *C. mrigala*

(Yerramenu) has been familiar to the Godavari fishermen even from their childhood and that the species now yields an important fishery, both in the river as well as in the connected tank system, strongly indicate that it has been naturally occurring in the Godavari all these years but was probably not so common as to attract attention, particularly since the belief hitherto has been that it does not occur in the Godavari.

Spence and Prater² dealing with the game fishes of Bombay, Deccan and the neighbouring districts state that all the species of *Cirrhina* listed by Day are found in the Deccan streams. However, the exact locality of Day's specimens of *C. mrigala* from the Deccan is not clear and so far as I am aware, the species is not known to occur in the Godavari, the Kistna or the Cauvery rivers. Dr. Rahimullah who has carried out an extensive survey of the fishery resources of the Hyderabad State informs me ¶ that "*Cirrhina mrigala* has not yet been found in the Hyderabad State" and that so far as he knew "It is a fish which is not found south of Nerbadda river".

The knowledge of the occurrence of *C. mrigala* in the river Godavari not only extends the range of distribution of the species southwards, but is also of considerable significance in furthering the culture of this carp in South India. Since 1943 the Madras Government Fisheries has been carrying out large-scale long distance transport of fry and fingerlings of *C. mrigala* and *Labeo rohita* from Bengal, with a view to establishing these prime food fishes in peninsular India.³ The attempts proved successful and these semi-exotic carps have been growing well in the departmental farm ponds and other controlled waters, but sufficient numbers have not yet been available for any large-scale planting in the rivers⁴. The availability of the 'Mrigal' in the Godavari makes transport of valuable seed of this wholesome carp to the rivers and tanks in the far south, obviously much easier and less expensive than transporting them all the way from Bengal or Orissa.

Freshwater Bio. Res. Stn., K. H. ALIKUNHI.
Government Fisheries, Madras,
October 23, 1948.

* Published with the kind permission of the Director of Industries and Commerce, Madras.

† My thanks are due to Dr. S. L. Hora for kindly confirming my identification.

‡ I am indebted to Messrs. S. Nagaraja Rao, S. H. Hussainy and D. L. Dikshithulu, of the Madras Fisheries, for carrying out the survey and arranging to transport a consignment of live fingerlings to Madras.

¶ Personal communication to the author.

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A MUTANT *CEDRUS DEODARA*, LOUDON

WHILE on an excursion with the East Punjab University Botanical Party led by Dr. P. N. Mehra this year to Mussoorie the writer came across a tree bearing abnormal male cones which it is thought worthwhile to place on record.

The normal male cone in *Cedrus deodara* is erect, solitary, cylindrical-ovoid and is about 1½ inches long (Photo 1). There is a single ring of vascular bundles in the cone-axis.



FIG. 1

On this tree there were borne almost exclusively what apparently looked like double male cones. A closer examination, however, showed that the cones are really single but while still young the cone-axis undergoes longitudinal fission. During further growth the two halves are outwards while still remaining united at the base and apex. At first therefore a depression appears in the centre (Photo 2) but later as the cone matures the two halves bend outwards so as to leave a gap in the middle giving a markedly double appearance (Photo 3 & 4). A transverse section through cone-axis in such cones shows the two halves of the cone-axis separate, each semicircular in outline and with its own half ring of vascular bundles. The cells at the region of the split turn brownish and develop relatively thicker walls.

To the writer's knowledge this variation has not so far been recorded in this species.

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Amritsar,
November 19, 1948.

T. N. KHOSHOO

SMUT ON THE MAT-SEDGE, *CYPERUS PANGOREI*, ROTTB.

Cyperus pangorei, Rottb.* (syn. *C. corymbosus*, Rottb.) is a smooth rush-like sedge growing in marshy places to a height of two to three feet, and used in South India and Ceylon for mat making. Smut appeared in a plot of this sedge in the laboratory garden in Bangalore towards the end of October 1948. The infection was at the bases of the peduncles and in the spikelets (Figs. 1 and 2). A reference to the literature showed a record of

identification of the species of the host. The same fungus is recorded by Petch⁴ as occurring on *Cyperus distans* L. f. collected by C. Driberg in September 1903 in Ceylon. The fungus was originally described by De-Toni⁵ as *Ustilago peribebuyensis* Speg. in peduncles of *Cyperus* sp. from Paraguay. *Cintractia* differs from *Ustilago* in the spores remaining firmly agglutinated and compact for a long time, the central columella of plant tissue, and the development of the spores from inside outwards.

Microscopic examination confirmed that it was a *Cintractia*. A transverse section through the base of the affected spikelet showed a central core of plant tissue consisting of fibrovascular and parenchymatous tissue. The younger spores were at the base passing out into mature spores which constitute a dense dark agglutinated layer. The stroma gives rise to dark brown strands of hyphae, with the fertile hyphae in between forming small pockets or clear compartments of spores which are at first pale, and later become dark and mature. The sori are present at the base of the peduncles forming swellings first covered by a whitish false membrane (Fig. 2), which soon ruptures exposing the dark-coloured spore masses. The sori occur on the spikelets also involving the rachilla and all portions of the flowers except the glumes, anthers, and styles (Fig. 2). The sori in the spikelets are also covered by a whitish false membrane which ruptures to expose the dark spores. The ovaries are transformed into smut sori, but the styles are unaffected, and may be seen sticking out from the tip of the sorus (Fig. 3). The spores are oblong to roundish and agree in measurements with those given by De-Toni for *Ustilago peribebuyensis*, Speg., viz., 12–13 × 8–9μ.

Several species of *Cintractia* are known to produce their sori in the ovaries of their hosts, but species affecting both peduncles and spikelets are few. According to Mc Alpine⁶ *C. densa* on *Rotibacella compressa* infects both the rachis and florets, while *C. exserta* on *Anthistria ciliata*, and *C. spinifex* on *Spinifex hirsutus* infect the spikelets, the latter destroying the ovaries also. In the absence of information on the exact species on which *C. peribebuyensis*, Speg. has been recorded in India, this is the first record of the fungus on *Cyperus pangorei*, Rottb. on the peduncles and spikelets.

Plant Pathology Sect.,
Dept. of Agriculture, S. V. VENKATARAYAN.
Bangalore,
December 1, 1948.

* I am indebted to Sri. S. N. Chandrasekhara Iyer, Government Lecturing and Systematic Botanist, Agricultural College and Research Institute, Coimbatore, for the identification of the host plant.

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FIG. 1. Two inflorescences of *Cyperus pangorei* showing typical smut infection.
FIG. 2. Sori at the base of peduncles, and left-hand figure showing infection of the spikelets.
FIG. 3. Infection of the ovary. Divisions of scale = 1/50 inch.

Cintractia peribebuyensis Speg. in the peduncles only of *Cyperus* sp. from several localities in India. Sydow, H. and P., and E. J. Butler¹ recorded it first from specimens of *Cyperus* sp. collected by Butler at Bilikere, Mysore on 19th September 1903. Butler and Bisby,² and Uppal, Patel and Kamat³ repeat the mention of this fungus without any additions or an



SEX REVERSAL (HETEROGAMY) IN THE JACK-FRUIT TREE, (*ARTOCARPUS INTEGRIFOLIA*, LINN.)

THE flowers of the jack-fruit tree (*Artocarpus integrifolia*, Linn.) are usually monoecious, on uni-sexual, axillary pedunculate receptacles. An abnormal inflorescence was noticed in a tree in Bangalore in September 1947. On the male receptacle, with the male flowers extending over a length of about two and a half inches, the female flowers developed on a side at the base for a distance of 0.8 inch in the linear axis, and 0.9 inch across (Fig. 2). Later in September 1948, the same tree bore on a branch, on the fourth receptacle from the tip a similar abnormal inflorescence (Fig. 1).



FIG. 1

The female flowers had pushed the male receptacle to a side by their growth. The male axis was about three inches long, by an inch and a half thick, while the female axis was also three inches long, and nearly two inches across. This kind of a change in the arrangement of the male and female flowers is known as heterogamy.

Instances of reversal in arrangement of flowers or the sexual organs have been observed. According to Masters¹ and several others in the cultivated maize, now and then one finds examples in which the sexes are mixed in one and the same inflorescence, the tassels which usually contain only male flowers sometimes bear female flowers (tassel seed). In the same manner but more rarely, the female inflorescences occasionally bear the male flowers (anther ear). Masters¹ states that in hops (*Humulus lupulus*) and *Urtica dioica*, the usually dioecious condition is sometimes changed into a monoecious condition with the female catkins at the end of the branch, and the male catkins below. Frank² has observed that in *Salix babylonica*, the weeping willow, there is a transformation of the stamens into pistils, and the pistils into stamens. A similar transformation has been observed by Cecil Yampolsky in *Mercurialis annua* (Robbins and Pearson³). Frank² states that in *Carpinus betulus*, some stamens occur in the female flowers. According to Robbins and Pearson,³ the late Prof. Rosa found in some strains of

spinach, "a considerable portion of the plants, purely pistillate in the early part of their flowering period, produce, later in the season, some staminate flowers towards the tip of the branches, especially of small lateral branches." Robbins and Pearson state that Cecil Yampolsky obtained in male plants of *Mercurialis annua*, stray female flowers some of which bore seeds, and the seeds produced all males.

These different sex conditions are supposed to be caused by factors definitely known to be located in the chromosomes. Some of these are known to produce, in maize, partial or total sterility or to modify the expression of either the staminate or the pistillate inflorescence or both.

The sexual forms of flowers have been found to vary with the changing conditions, within and around the plant, and often with the time of the year. Robbins and Pearson³ report an interesting case of change in physiological conditions causing a change in sex of flowers in the Hawaiian Islands, "where some one cut off a male papaya tree, and the new shoots which came up from the stump were all female!" Schaffner⁴ succeeded in obtaining sweet corn plants whose tassels showed reversal to the pistillate condition by shortening the length of day; the ratio of sex reversal was inversely proportional to the length of the daylight. Little or no reversal occurred with equal day and night periods. He concluded that the sex-reversal might be independent of any sex-determining factors. It is well known, however, that genetic factors do come into play, but that they may be influenced by the environment.

Some fungi are known to cause the development of dormant or rudimentary structures and to induce the growth of entirely new organs. According to Butler,⁵ stamens that normally are rudimentary in the pistillate flowers of *Lychnis* (*Melandrium*) *dioica*, when attacked by anther smut (*Ustilago violacea*) in Europe, grow to full size, but only produce smut spores instead of the pollen grains, and buffalo grass (*Buchloe dactyloides*) may form ovaries in its staminate flowers when parasitized by the smut fungus, *Tilletia buchloana* in America.

According to Baker⁶ recent observations by Love, A., and Love, D., have shown that the development of stamens in pistillate plants of *Lychnis* (*Melandrium*) may be brought about by treatment of plants with the animal hormone testosterone, while the reverse change has been caused by oestrone. Baker notes that when such change occurs some secondary sexual characters also develop, but other characters persist, because they are sex-linked. Infection by the smut or the application of testosterone can promote the formation of stamens, and suppress the formation of pistils.

Rhizopus artocarpi is a common fungus on the male inflorescences of the jack-tree, but the infected receptacles soon drop down. Apparently this infection cannot bring about the sex-reversal. The abnormal inflorescence was noticed to be infested with some mealy bugs, though not in large numbers (Fig. 2). The tree was subject to frequent cutting off

of the lower branches accidentally or intentionally, and it is possible that this or the cumulative effect of all the adverse factors may have brought about the reversal of sex.

Plant Pathology Section,
Dept. of Agriculture, S. V. VENKATARAMAN.
Bangalore,
December 1, 1948.

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A NOTE ON THE AMPHIDIPOID OF THE HYBRID OF *PENNISETUM* *TYPHOIDES* STAPF. AND HUBBARD *P. PURPUREUM* SCHUMACH.

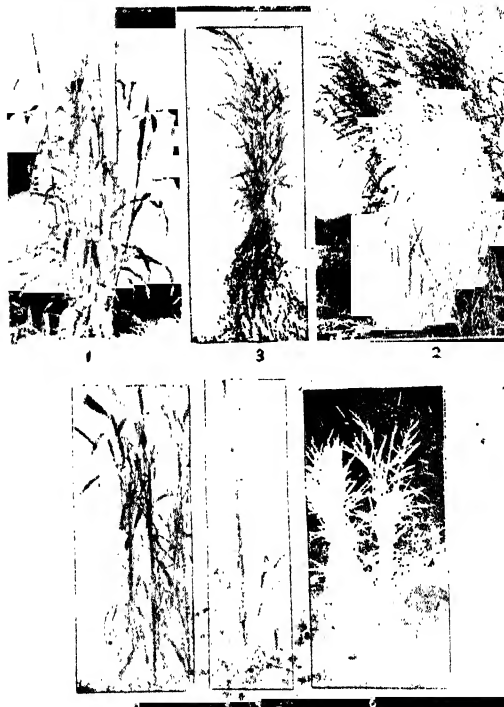
BURTON¹ (1942) obtained the interspecific hybrids of *P. glaucum* (L) R. Br. (syn. *P. typhoides*, Stapf. and Hubbard.—the pearl millet) and *P. purpureum* Schumach. the Napier or the elephant grass used as the female parent. He obtained chlorophyll variations even in the F_1 s, viz., green and yellowish green types. The hybrids were triploid and highly sterile. On back crossing the F_1 s, to both parents (used as pollen parents) he obtained one plant out of 5,000 spikelets sown in each case.

In 1942 the senior author obtained independently, hybrids using a male-sterile pearl millet plant as the female parent. The hybrids showed chlorophyll and vigour differences similar to Burton's observations. Since then it has been found that F_1 s, are easily produced whichever the stigma parent may be whether the diploid or the tetraploid species. However, having the cultivated, diploid as the female parent has its advantages in that the spikelets are not shed and the hybrid plants are easily recognised.

Since obtaining the hybrid attempts were constantly made to induce doubling of the number of chromosomes in the hybrid plant. Treatments of the seeds or the seedlings with aqueous solutions of 0.4% colchicine were not successful. The retardation of growth in the roots and shoots induced by colchicine treatment caused the ultimate death of the treated material. When it was realised that the cuttings of the stems of three internodal lengths could easily be made to strike root and the hybrid thus propagated, recourse was taken to treat the axillary buds with colchicine. The sets when planted in water produced an abundance of roots and the bud started growth.

These active axillary buds were chosen for treatment. The scale leaves were removed and the growing point exposed to a safe limit by removing the young sheathing leaves around it. The buds were then treated with 0.4% colchicine emulsion in lanolin for nearly a

week. Treatments with aqueous solutions were also done. The sets were then transplanted into pots and thence into the field. Other kinds of treatments like injection of the fluid into the sheath near about the growing point with a hypodermic syringe, treatment with acenaphthene all failed. Out of a dozen sets treated and transplanted one set alone showed tillers with complete fertility in the panicles. In this set out of the three buds treated only one has become affected while the other two have remained unaffected (Fig. 6).



1. *Pennisetum typhoides* diploid, $\times 1/20$; 2. *P. purpureum*, tetraploid, $\times 1/40$; 3. F_1 , triploid, $\times 1/40$; 4. F_2-1 hexaploid $\times 1/30$; 5. F_2-2 , $\times 1/30$; 6. C-induced amphidiploid the right-hand clump. The left hand clump is not affected. $\times 1/50$ nat. sizes.

Simultaneously a large quantity of the mature spikelets from the hybrids was sown. From them three seedlings were obtained of which two survived. Seedling F_2-1 is more vigorous than the F_2-2 and has broader and longer leaves (Figs. 4 and 5). In the appearance of the vegetative parts both resemble more the pearl millet than the elephant grass. The stems are softer, not woody and the nodal adventitious roots dormant as in the pearl millet. The two plants produced panicles, thin with long bristles, fewer and more distantly arranged spikelets resembling those of the elephant grass. The flowers are protogynous. The emergence of the stamens, however, is as in the pearl millet. The pollen treated with iodine showed high fertility in contrast to the hybrid plant. The F_2-2 has very low vigour and slower growth. Consequently the examination of the root tips of this plant has been deferred till it picks up more strength,

TABLE I

Plant	Veg. characters (Perennial or not, rhizomatous or not)	Leaves coriaceous and hairy	Anther emergence	Ht. of plant in cm.	Pollen diamet. r in μ	Fertility %	Chromo- some num- bers $2n$. ($x = 7$)
<i>P. typhoides</i> ♀ parent	Annual. Non rhizo- matous	Somewhat coria- ceous very sparsely hairy	In full flush	270	39.18	98.6	14
<i>P. purpureum</i> ♂ parent	Perennial Rhizoma- tous	Coriaceous, hairy	Slow, not in full flush	420	42.46	95.9	28
Hybrid F_1	Perennial. Non- rhizomatous	Intermediate, hairy	Slow in flush, sterile	420	34.43	1.6	21
F_2-1	Probably perennial, Non-rhizomatous? Like mother	Like mother	Full flush	283	60.01	92.8	42
F_2-2	do	Like mother. Leaves narrow	do	283	56.2	74.0	c. 35
C-induced fertile shoots	Probably perennial Like male parent	Like F_1 , shorter and broader	Full flush	430	60.01	92.8	42

The F_2-1 has shown 42 chromosomes in the somatic cells.

The bud that showed colchicine effect has produced about ten shoots. The vigour of these shoots is slightly more than that of the shoots from the unaffected buds. The stems are thick and woody. The peculiar growth habit of the elephant grass with sugarcane-like appearance and the older stems becoming woody with adventitious roots developing from the nodes is continued in the induced shoots, while in the seedling F_2 s, this habit is absent and the stems are more tender. The leaves are somewhat shorter and broader. The panicles in appearance are like that of the elephant grass. The emergence of the anthers is in a flush as in the pearl millet and the fertile pollen is formed in plenty. The pollen mother-cells of this plant were examined cursorily in iron-acetocarmine and it was found that the chromosome number was $2n=42$, showing that doubling had taken place.

P. typhoides is diploid with 14 somatic chromosomes (Fig. 1). The Napier or the elephant grass has two types (1) with anthers emerging slow and thinly arranged spikelets (Fig. 2), and (2) with anthers emerging in a flush and closely arranged spikelets. Both have the same chromosome number, viz., $2n=28$. The first type was used as the male parent in the hybrid reported here. Thus *P. purpureum* is a tetraploid species. The hybrid is triploid with $2n=21$ (Fig. 3). The cytogenetical behaviour of the two amphidiploids and their progeny would be highly interesting since the induced one differs greatly from the one obtained from the F_2 , and the F_1 , shows pairing affinities between the *P. typhoides* and the *P. purpureum* genomes. The F_2 plants also show multivalent formations in the P.M. Cells. The behaviours of some of the prominent characters are summarised in Table I above.

The detailed cytological behaviour of these plants are being studied. Hybridizations between the $2n$ and $6n$ plants and also between the different *Pennisetum* species are being done. In the F_2-2 a rough examination of the P.M. Cs. showed multivalent formation and the exact numbers of chromosomes will be reported elsewhere after its determination, in the root tips.

It is suggested that the amphidiploid may be named as *Pennisetum purpureotyphoides*.

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Lawley Road P.O.,
December 11, 1948.

I. Burton, G. W., *J. Hered.*, 1944, 35, 227.

ANGULAR LEAF-SPOT OF KUDZU IN MYSORE

A *Cercospora* leaf-spot disease of kudzu (*Pueraria thunbergiana* Benth.) was observed in Bangalore, South India, on some of the plants grown for experimental purposes. Kudzu is a leguminous cover crop introduced in Bangalore from imported seeds. The fungus incited severe spotting of the leaves and hastened defoliation. Young lesions were light brown and gradually widened into dark-brown angular spots. When large areas were involved, the leaves dropped off.

Similar angular spots of kudzu causing severe damage in Georgia, United States, was recently reported by Weimer and Luttrell¹ as due to *Mycosphaerella Pueraricola* (Yamamoto) Weimer and Luttrell. Its conidial stage *Cercospora Pueraricola* Yamamoto was first recorded in Formosa (Yamamoto²) and

later in China (Tai¹). It has not so far been recorded from any other place in the Orient. *C. Puerariae* Syd. reported from the Philippines on *Pueraria Phaseoli* is a different species. Weimer and Luttrell assume that *Myosphaerella Pueraricola* has been introduced into the United States along with kudzu seeds imported from Japan.

Microscopic studies of the diseased kudzu leaves collected in Bangalore, revealed the tufts of conidiophores arising from the pseudoparenchymatic stroma. They were amphigenous, but mostly hypophyllous, simple, olive-brown, 1-6 septate, $85-180 \times 3.5-4.5 \mu$. Conidia were hyaline, obclavate to cylindric, filiform at the apex, up to 15-septate, $85-170 \times 3-3.5 \mu$. The conidia and the conidiophores were therefore slightly larger than the measurements given by Weimer and Luttrell for *M. Pueraricola* (conidiophores $20-84 \times 4-4.5 \mu$, conidia $25.2-126 \times 3.5-3 \mu$).

The present record of *Cercospora* on kudzu plants in Bangalore grown from imported seeds is of interest since no *Cercospora* species is known on kudzu or *Pueraria tuberosa* DC. the only indigenous species known in South India. Care should be exercised in preventing the spread of the disease if large-scale cultivation of kudzu is undertaken.

Bangalore, M. J. THIRUMALACHAR.
December 15, 1947.

1. Tai, F. L., *Bull. Chinese Bot. Soc.*, 1936, **2**, 45-66.
2. Weimer, I. L. and Luttrell, E. S., *Phytopathology* 1948, **38**, 348-58. 3. Yamamoto, W., *Trans. Sapporo Nat. Hist. Soc.*, 1934, **13**, 139-43.

PRODUCTION OF THYMOL FROM AJOWAN SEEDS

AJOWAN oil distilled from the seeds of an umbelliferous plant, the ptychotis ajowan (*Carum Copticum*), is an important source of thymol in India.

A general survey of the oil content of the ajowan seeds gathered from the villages of Punjab is made in this laboratory. Steam distillation of the coarsely ground seeds is best for the extraction of the oil.¹ Treatment of the coarsely ground seeds with solutions of different concentrations of alkalis or salts followed by steam distillation lowers the yield of the oil.

Iklas seeds give a maximum average yield of 4.2% of oil on the weight of the seeds.

Thymol in ajowan oil is estimated by its conversion into iodo-derivative and titrating the excess of iodine.² The oil from the seeds of Iklas and Sabazpur contain respectively 39.3% and 36.2% thymol on the weight of the oil. Method of Dodge³ presents difficulties due to the formation of stable emulsions.

EXTRACTION OF AJOWAN OIL

TABLE I

Method: Steam distillation. 100 gms. of coarsely ground seeds used in each distillation

Distillation	Locality of seeds	Yield of oil in gms.	Colour of the oil
1	Nagawali	2.85	Light yellow
2	"	2.99	"
3	Pindighels	3.63	Golden yellow
4	"	3.53	"
5	Domeli	3.97	Light brown
6	"	3.83	"
7	Sabazpur	4.18	Light yellow
8	"	4.13	"
9	Iklas	4.15	"
10	"	4.23	"

TABLE II

Method: Steam distillation. 100 gms. of coarsely ground Iklas seeds used in each case after treatment with alkali or salt

Distillation	Treatment	Yield of oil in gms.	Colour of the oil
1	Kept 8 hrs. with 500 c.c. 5% NaOH	0.5	Light brown
2	" " " 1% NaOH	1.01	Brown
3	" " " 2N NaCl	1.53	"
4	" " " 5N KNO ₃	2.23	"

According to Chopra and Mukherjee⁴ the seeds from different parts of the country yielded varying proportions of oil ranging from 2.0 to 3.5%. Seeds obtained from the Kurnool-Guntakal district of Madras Presidency appeared to be the best obtainable in India. These seeds gave a high yield of oil, i.e., 3.5%. The seeds obtained from Northern India yielded only 2.97% of the oil, and the percentage of thymol in most of the Indian oils is not more than 33 to 37%.⁴ This publication is delayed due to the political changes at Lahore.

Technical Chem. Laboratory,
Forman Christian College,
Lahore,
November 25, 1948.
JAMES VERGHE E.
K. C. GULATI.
M. L. JOSHI.

1. Inuganti, Bhat and Hassan, *Industries and Commerce, Nizam Govt. Publication, Bull.* 1924, **8**, 2-3. 2. Allen's *Commercial Organic Analysis*, **4**, 138. 3. Dodge, *Amer. Perfumer*, 1939, **35**, **4**, 39. 4. Chopra and Mukherjee, *The Ind. Med. Gaz.*, 1932, **67**, 361-62.

WOODEN PANS FOR SUGARCANE SEEDLINGS

In the September (1948) issue of the *Current Science*, Dutt, Rao and Davis reported a better output, growth and uniformity of sugarcane seedlings grown in glazed clay pans as compared to country-made earthenware pans. Our own experience with earthen pans in the Co. S. seedling work at Shahjahanpur was similar to that of the Coimbatore workers, but we have changed over to wooden pans, which we find very satisfactory. Pans made of dealwood were first tried by Dr. A. K. Mitra in 1942 for replacing some of the earthen pans broken in handling; these dealwood pans were found so promising that the writer made a complete change over to pans made of *Sal-wood* (*Shorea robusta* Gaertn.) in 1945; and our past four years' experience with the latter has more than justified the change from earthenware to wood. Our *Sal-wood* pans compare favourably with earthen pans (and presumably with glazed pans also), as may be seen from the statement below:—

	Truncated conical earthen pans	Square box- shaped wooden pans
Cross dimensions at top and outer edge ..	13 in.	12 in.
Cross dimensions at soil surface ..	11 in.	11 in.
Approx. weight per pan ..	9½ lb.	7½ lb.
Approx. area of soil surface per pan, available for sow- ing fluff ..	95 sq. in.	121 sq. in.
Approx. vol. of soil contain- ed per pan ..	372 c. in.	635 c. in.

It will be seen from the above that, pan for pan, (1) wooden pans are 24 per cent. lighter in weight, (2) provide 27 per cent. more soil-surface for fluff and (3) hold 70 per cent. more soil for seedlings than earthen pans. On a given area of bench-space, wooden pans being square in shape with erect sides, provide more soil-surface than the earthen pans, which, being round and due to their sides diverging outwards, consume bench-space needlessly; the walls of wooden pans are also thinner. All said, with a change-over to wooden pans, we were able to effect a substantial increase in seedling output without addition to bench-space. Like glazed pans, these wooden pans also provide a uniform depth of soil for all the seedlings grown in the pan. In addition, wooden pans are easier to handle and breakages are negligible; repairs, if any, are simple and a matter of minutes. The cost as compared to glazed pans is very low (we paid a wartime rate of Rs. 1-12 per pan in 1944), and as there are practically no recurring costs and replacements, the cost of pans per year works out lower than with even country-made earthen pans. As is well known, *Sal-wood* does not rot through prolonged contact with water as other woods do, and a mere coating of coal-tar has been sufficient to keep off termites. We could have employed some of the new termitifuges

in the market, but this has not been found necessary here. As may be seen from the photograph, seedlings come up very well in these wooden pans, and in the writer's opinion,



wooden pans are better in every way than country-made earthen pans or factory-made glazed clay pans.

As regards the health and growth of seedlings, our experience is that the quantity of fluff sown per pan has a greater effect on the condition of the seedlings than the shape of the pan or the material of which it is made. At first we were also using 2 gm. of fluff per pan, but as the seedlings came up weakly and were rather under-developed at transplanting time, we reduced the rate to 1.5 and later to 1 gm. per pan, and this proved advantageous. Now we are sowing only 0.75 gm. of fluff per pan. It is possible, however, that in noble-cane crosses and other hybrid fluff of known low viability, the fluff rate can or should be higher. We had some *Phytophthora* damping off of seedlings, but we overcame this trouble by reducing the fluff-rate per pan and also by sterilizing the soil, which means merely stirring it in sunshine daily for a few days before preparing it for the pans.

As a result of all these improvements, we have not only considerably increased the seedling output, but have also reduced our transplanting mortality markedly. It would perhaps be worthwhile trying wooden pans in place of earthen pans, before changing over to glazed pans.

Sugarcane Research Station, R. R. PANJE.
Shahjahanpur,
November 27, 1948.

SOME OBSERVATIONS ON JUICES OF
DISEASED SUGARCANE

It is well known that a considerable drop in juice quality is brought about by cane diseases like red rot (*Colletotrichum falcatum*) and Wilt (*Cephalosporium sacchari*) and the juices of such diseased canes are particularly difficult to clarify both in the vacuum and open pan systems of manufacture. Apart from the fall in sucrose and purity per cent. detailed knowledge in respect of non-sugar ingredients (which largely determine clarifying properties) is singularly lacking, being restricted to some casual observations in the literature such as that made by Kortscher (1939) to the effect that in diseased canes, exceptional quantities of gum are apt to occur.

In this note, some preliminary results of interest in respect of juices from red rot and wilt affected canes, originating from different areas in Bihar are briefly reported. In addition to determinations of Brix, Polarisation and Invert Sugars, the following non-sugar ingredients (important from the technological view-point) were also examined in these studies, in accordance with analytical methods indicated against each:—

Total Colloidal Matter (Kharin and Smirnova, 1936), Gums (Ruff and Withrow, 1922), Pectin (Farnell, 1924), Crude Protein (Total Organic Nitrogen $\times 6.25$), Ash and Phosphate contents (Pemberton, 1893, 1894).

Although a number of samples from different localities in Bihar was examined, only typical

cases representing a fairly heavy attack of the two diseases have been shown in Table I. It will be evident from the table that besides the losses in sucrose, increases in invert sugar, colloids (total as also of different categories) and ash contents are occasioned by the red rot disease. The same trend is manifested with regard to changes caused by wilt, although to a much smaller extent. In so far as the present investigations appear to indicate. The highly deleterious effect of large quantities of all these ingredients (except phosphate) on the clarifying properties of juices undoubtedly account for most of the milling difficulties experienced. Further work is in progress.

The work was carried out as part of the Sugarcane Research Scheme in Bihar being financed jointly by the Government of Bihar and the Indian Central Sugarcane Committee, to whom grateful thanks are due. The assistance rendered by Mr. S. A. Rifay, Sugarcane Pathologist, in supplying samples of material is also acknowledged.

Central Sugarcane
Research Station,
Pusa (Bihar).

K. L. KHANNA.
A. S. CHACRAVARTI.

December 28, 1948.

1. Farnell, *Internat. Sug. Jour.*, 1924, **25**, 480.
2. Kharin and Smirnova, *Ibid.*, 1936, **38**, 447, 109.
3. Kortscher, *Hawaii Planters' Record*, 1939, **43**, No. 1 (October).
4. Pemberton *Jour. Amer. Chem. Soc.*, 1893, **15**, 382-95.
5. *Ibid.*, 1894, **16**, 278-82.
6. Ruff and Withrow, *Ind. Eng. Chem.*, 1922, **14**, 12.

TABLE I

Showing changes in Juice Criteria of Red Rot and Wilt Affected Cane

(a) Red Rot
Variety : Co 331

(b) Wilt
Variety : Co 385

Sl. No.	Ingredients*	Healthy	Diseased	Per cent change due to disease	Healthy	Diseased	Per cent. change due to disease
1	Brix	19.90	9.50	-52.3	18.40	12.80	-30.4
2	Polarisation	17.58	4.62	-73.7	15.29	7.30	-52.3
3	Purity	88.50	48.60	-45.1	83.10	57.03	-31.4
4	Invert Sugars	2.46	25.47	+93.54	2.50	12.19	+388.8
5	Total Colloids	2.41	11.16	+362.7	6.40	8.61	+34.6
6	Gums	0.27	1.26	+366.1	0.83	1.25	+51.7
7	Calcium Pectate	0.29	0.88	+198.6	0.12	0.16	+36.7
8	Crude Protein	0.53	1.41	+164.5	2.28	3.72	+63.3
9	Ash	2.01	6.53	+224.4	3.72	7.30	+96.4
10	P ₂ O ₅	0.11	0.18	+61.3	0.13	0.19	+49.6

* Ingredients 4 to 10 are expressed as percents on Total solids.

VINCENT MASSEY SCHOLARSHIP

THE Secretary of the Vincent Massey Scholarship Selection Committee informs that the Committee invite applications for the Vincent Massey Scholarship for 1948-49 and 1949-50 of the value of \$2,000 (inclusive of all expenses) which is tenable for one year for post-graduate

work (ordinarily Master's degree) at the University of Toronto. Details about the Scholarship, which is open to all men candidates belonging to India and Pakistan, the Secretary says, can be obtained from him by writing to him at 5, Russell Street, Calcutta 16.

REVIEWS

Oceanic Birds of South America. By Robert Cushman Murphy. 2 Volumes. (The Macmillan Company, New York), 1948. Pp. 1245; 73 photographic plates; 16 colour plates; 80 text illustrations. Price \$17.50.

Robert Cushman Murphy is a name that stands amongst the topmost rungs of the ornithological ladder to-day. He is the distinguished chairman of the Department of Birds in the American Museum of Natural History, New York, and in his own particular sphere recognised amongst the world's foremost authorities. This work, first published by the American Museum of Natural History, New York, in 1936 was hailed as the most exhaustive and outstanding contribution to the subject of oceanic birds and ran out of print within the first few months. It has been greatly desired and sought after by serious bird students throughout the world, and therefore it is particularly gratifying to find that Messrs. Macmillan's have now undertaken to reprint it. The contents, both text and plates—the latter by the well-known bird artist Francis L. Jaques remain unchanged.

At the time the book was written Dr. Murphy was Curator of Oceanic Birds in the New York Museum. He had specialised for many years in the study of sea birds and taken part in many cruises of investigation. His fascinating book "The Bird Islands of Peru" published in 1925, which deals largely with guano and the birds responsible for its production on islands off the Peruvian coast is a record of the greatest value.

The present volumes are based principally on collections made by the Brewster-Sanford Expedition between 1912 and 1917, continued later by the author himself, and supplemented by previous material obtained sporadically and haphazardly at different times by various voyagers and found scattered in many museums. The late Mr. Rollo Beck assisted by his wife who was responsible for the major part of the Brewster-Sanford collections must indeed have been a remarkable man. The collection made by him numbered well over 7,000 specimens, fully representative of the South American sea-bird fauna including most of the truly pelagic forms and also many little-known rarities.

The difficulties of collecting far-ranging ocean birds are obvious. Members of the *Procellariiformes*—albatrosses, fulmars, shearwaters, petrels, etc.,—spend most of the year on the high seas, far from land and are only occasionally blown into coastal waters by storm. They breed on oceanic islands so remote and off the beaten track that many species still have their breeding grounds undiscovered.

To one with any experience of collecting birds, Mr. Beck's proficiency and thoroughness will sound phenomenal. We are told that he often got as many as 40 specimens a day, all prepared with uniform excellence and with complete data concerning soft parts, stomach

contents and field notes in addition to excellent photographs. If he has any experience of collecting sea birds, even in littoral waters, he will realize more readily the magnitude of the successful collector's task, particularly in bad weather. Little wonder then that Dr. Murphy extols Beck as "the most successful worker in this branch of ornithology that the world has known".

To the collections of the Brewster-Sanford Expedition Dr. Murphy added material from South Georgia, the littoral of Peru, Ecuador and Venezuela and the Galapagos archipelago, and supplemented this further by specimens from Fernando Noronha, South Trinidad, St. Helena, Ascension and others, short descriptions of the flora, fauna and avifauna of all of which are furnished. During the preparation of the work the author made an examination of practically all available material of oceanic birds in the museums of the United States and abroad. From this and from the impressive bibliography given at the end may be gleaned some idea of the scope and thoroughness of the information presented in these volumes.

Part I of Vol. I (the first 322 pages) is what makes this book so refreshingly different and so particularly valuable to students, even though their special interest may not lie in the sphere of oceanic birds, or in the region with which it specifically deals.

Among the subjects dealt with, and of rather more general interest, are Meteorology, Hydrology in relation to oceanic birds, the Nutritional Basis of Marine Life, the Zones of Surface Water, and Ocean Currents. The discussion of Birds and Hurricanes (pp. 53-59) and the responsibility of the latter for the fortuitous transportation of sea birds to distant extralimital areas, and for mortality among them is particularly illuminating.

A detailed account of the Guano industry follows. The chief guano producing bird on the Peruvian islands is the Guanay (a cormorant—*Phalacrocorax bougainvillii*), the next two in importance being the Piquero, a species of Gannet (*Sula variegata*) and the Alcatraz, (a pelican—*Pelecanus occidentalis thagus*). The guano deposits, we learn, are thousands of years old and in some places are, (or were—since they have been ruthlessly exploited) over 20 metres in thickness. The average annual yield from this area is over 100,000 metric tons. When it is realized that guano as a fertilizer is 33 times more effective than farmyard manure, the economic importance of the birds producing it will be truly appreciated. "The wild story of the early years of guano exportation, which Peruvian historians refer to as a 'saturnalia' is not likely to be familiar to many readers to-day" says Dr. Murphy, and the details he gives of the guano-fever which raged about the middle of last century with sordid competition amongst international adventurers and the accompanying "greed and corruption... and dust-gagged misery and slavery" (more fully described

in his "Bird Islands of Peru") make as dismal a commentary on our so-called civilization as any that one can recall of the exploitation by Man of his less fortunate fellows.

Part II—The Oceanic Birds—which commences at p. 323 and runs on through the second volume, contains a systematic account of all the truly Antarctic species including littoral, in-shore, off-shore and pelagic birds. In spite of the enormous collections he was privileged to handle, the author deplores the lack of adequate series of many forms over the entire breeding range of many a genus.

The arrangement and nomenclature followed are those of Peter's 'Checklist of the Birds of the World'. The total number of forms dealt with is 183 contained in 16 families of the Orders Spheniciformes (Penguins), Procellariiformes (Albatrosses, Petrels, etc.), Pelecaniformes (Pelicans, Cormorants, Tropic-Birds, etc.), Anseriformes (Geese and Ducks), Charadriiformes (Oyster-catchers, Skuas, Gulls, Terns, etc.). Each order and each family are suitably introduced. 10 forms of penguin (out of the 17 recognised) are discussed, together with their probable ancestry, and theories about their flightlessness. In Procellariiformes, classification, stomach oil, evolution, nidification, enemies and feeding are aspects exhaustively dealt with, as also are economic status, distributional range, habits and moults, etc.

The so-called Steamer Ducks (*Tachyeres*) have long been a subject of controversy and argument among ornithologists, some maintaining that the flying and non-flying forms were but young and adult phases of a single species, others that they belonged to 2 entirely distinct species. From a critical examination of a large series covering all ages, all seasons, both sexes and the entire range of the genus, Murphy has been enabled to prove (p. 953) that actually not two but three species are concerned: 2 flightless (one confined to the continental littoral, the other to the common Falkland Islands) and one flying, which is common to both these areas.

The author suggests (p. 1101) that although the Arctic Tern *Sterna paradisaea-macrura* has been taken in the Antarctic as far south as 74° S. lat., the belief that it regularly migrates across the world from the Arctic to the Antarctic, making a round trip of 22,000 miles each year may "yet prove to be a far-reaching ornithological illusion". He shows that the very similar Antarctic Tern (*S. vittata*) which is a resident in the Antarctic and breeds on South Orkney Islands and elsewhere, November to January, has largely and often been confused with the Arctic Tern in published southernmost records. If Murphy's well-documented view is correct, we cannot help regretting that one of the most spectacular legends in the realm of bird migration will have been dissipated, thus adding one more victim to the toll that prosaic science is constantly and relentlessly exacting from sensational romanticism!

"Oceanic Birds of South America" constitutes as complete and useful a manual as can be

conceived. It is a synthesis of painstaking research in field, museum and literature; a book on ecological lines, which treats sea birds not as independent entities, but as parts of the general ocean environment. All the physical factors affecting their lives are carefully considered and analysed. Dr. Murphy's achievement sets a standard in bird books which other writers might do well to emulate.
S. A.

The Biology of Melanomas. Special publications of the New York Academy of Sciences. January 1948. Vol. 4. Pp. 1 to 466. \$ 5.00.

The task of reviewing this symposium is very difficult as each article has been written by an expert in his special field and is a complete statement as well as a review, and therefore requiring special study. There are 26 articles on pigment cell biology; a foreword by Myron Gordon and an introduction by R. G. Harrison. This introduction is a masterpiece, as it succinctly surveys the whole field while introducing the modern ideas of pigment formation in biology; it reminds one of *nandi* slokas of one of Kalidasa's dramas where the subject is introduced and where the drama is given a whole glimpse in a few simple words. "Animal colouration has excited the curiosity of man from time immemorial"—"Permanent coloration of organisms is also of great interest"—"including mimicry". The pigmentary system has some of the most malignant tumours known. The study of colour changes shows that the mechanism of control is very complex and depends on nervous control, hormones circulating in the blood, as also environmental factors such as light, temperature, and colour patterns of the surroundings. The skin colour in the amphibia or the plumage of birds, etc., show slowly or quickly changes; many such changes are very slow and are often or at least for the most part irreversible.

The source of pigment cells.—A whole article is devoted to it by Dushane. Within the last dozen years, conclusive proof of the origin of pigment cells was advanced. The origin of the Chromatophores from the epiblast is that these are arranged in sheets and can be subdivided into two—Dermal and Epidermal—layers. They are also found in the nervous system; in mammals only melanophores—found largely in the epidermis remain—the pigment granules passing on to the epidermal cells. Definite experimental evidence by tissue culture and other methods have been obtained by Harrison, Weidenreich and others.

The distribution of Pigment cells in man is discussed by Dr. P. Masson. (This subject is of importance in India where—Vitiligo—depigmented or white areas surrounded by black skin or white leprosy are common and have social stigma.) Pigment cells in mammals have an ectodermal origin. Human melanin is a granular material. Melanin is not black as the name would suggest but varies from dark brown to pale yellow. The silver reaction—i.e., Dopa reaction—darkens all melanins and is a good cytological staining reagent and can

be made satisfactory if the conditions are properly observed. The term *melanoblast* is reserved for the cells which manufacture pigments and *melanophore* to cells which store such pigments, without manufacturing them. The reagent of melanogenesis happens to be an oxidase (-3-4 dihydroxyphenylalanine—'dopa'—for short)—an oxidase acting on the polyphenolic aromatic compounds called Chromogens. Melanoblasts can have momentary activity—as in the eye; or permanent or variable activity—(epidermis and mongolian spot).

Regarding Dermal pigmentation—the pigments are proportional to the intensity of the neighbouring epidermal pigmentation, i.e., in heavier concentrations in dark skinned races. The melanin is imbedded in the more superficial stellate cells of the papillary derma. These cells do not produce the pigment but contain the same in tattoo like granulations. The malpighian cells were thought to be capable of producing melanin; the function of actinic rays is not to manufacture melanin but only to tone the already existing preformed melanin to darker shades; actually the malpighian cells have the pigment brought to them from epidermal melanoblasts.

Hence these melanoblast are glandular secreting cells which send their secretions to other cells; hence they can be called *Cytocrines*. In vitiligo the cells are no longer dopa positive. On the other hand, the melanoblasts load cancer cells with pigment even by *migrating* into intradermal neoplastic strands.

In a clinical study of the pigmented naevi and melanomas, George Pack states that the malignant melanoma or simply melanoma is the most malignant of all accessible cancers; such cancers are most commonly found in blondes though others—brunettes, etc.—are not so completely insusceptible to such melanomata. Pigmented naevi are often apt to turn into melanomata, hence a cytological study should be made of all such excised moles. Melanomas are also notoriously radioresistant. When melanoma in the eyes are removed, metastases occur in the liver where they are known to be quiescent for a number of years. If such tumours occur in the genital organs they are extremely malignant. In a study of melanin pigmentation by William Becker it is made out that in vitiligo, the three cardinal functions of the clear cells have been lost, namely, dopa positivity, dendritic contour and pigment formation.

Samuel Go'dberg discussing the origin of melanoblasts points to the possibility of some melanin pigment cells being of mesodermal origin. (An old view—later given up—owing to the preponderating evidence in favour of ectodermal origin.)

The association of Acanthosis Nigricans (a pigmentary discolouration in the axilla, groin, etc.) with gastric, hepatic and other cancers, is very striking and is emphasised by Madge Macklin.

Various studies on animal melanomas—study by tissue culture method, of melanomas in fish, mouse, human, etc., are also listed.

The effect of five primary genes on the site of melanomas in the mexican platyfish is discussed by Myron Gordon. This is an extremely interesting but very difficult piece of work. Melanotic tumour transplantation has been done to study the effect of melanin formation by transplantation between albino and pigmented grey Axolotl.

Morphological colour changes in the vertebrates is discussed thoroughly by Odrione from various angles. The loss of the pigmentation in hair—changes in birds, fish, hormonal control of pigmentary changes are some of the subjects discussed.

The biochemistry of Melanins and the formation of melanotic tumours are discussed by a number of authors and it will be worth a thorough perusal of the symposium. It may be stated that the subject though difficult, is interesting and the symposium has sought to integrate various view-points as also to show the way for future work. Such books are always welcome.

C. V. NATARAJAN.

The Escalator Method in Engineering Vibration Problems. By Joseph Morris. (Chapman & Hall Ltd., London), 1947. Pp. xv+270. Price 21sh. net.

It would appear that the title of this book was chosen by its mathematical author to intrigue and impress those who have become entangled in engineering vibration problems. Doubtless it succeeds in so doing, which the reviewer considers to be all to the good as, from personal knowledge of the author and his work, he can endorse the appreciation expressed by Professor G. Temple, F.R.S., in the Foreword.

Of the twenty-two chapters, the first six relate to static deflection and stress problems concerning Rods and Structures. These are relevant to the vibration problems examined later but not specifically to the Escalator method. In one of these chapters, Captain Morris gives an important original extension of the Hardy Cross method of moment distribution in redundant structures.

The next three chapters relate respectively to Lord Rayleigh's reciprocal theorems, Approximate methods of determining vibration frequencies, and the Whirling of rotating shafts.

In Chapter 10, the Escalator method of solving Lagrangian frequency equations is introduced. To quote words the reviewer heard Mr. Head use in an open discussion at a professional institution, the basic method had occurred to him as a "blinding flash of the obvious". Captain Morris had immediately appreciated its importance and had developed it in conjunction with Mr. Head and with the strenuous assistance of Mr. W. J. Evans, B.Sc., in dealing with the onerous exploratory computations involved. An important variant of the method, of which an account is given in the book, is the "Escalator in reverse" whereby the solution of certain problems is much facilitated. This useful artifice appears to be due Captain Morris (*vide* page 138).

In the succeeding chapters of the book, the escalator method is developed in application to the determination of modes and frequencies of vibration for various complex dynamical systems present in aircraft. In particular, coupled engine torsional and propeller flexural vibration is treated in Chapter 14. It would have added to the value of the book to engineers if more generous references had been made to the work of others in this field in respect of both mathematical treatment and experimental observation. Although the escalator method affords a very valuable new instrument for dealing with special problems, other methods not referred to have their application and their merits.

The book has three appendices. Appendix I is a note on numerical integration taken, with due acknowledgement, from Searle's "Exoerimental Elasticity". This describes a variant of Simpson's method in which non-uniformly spaced ordinates are used. It is a matter of interest that Simpson's First Rule was given before Simpson's time by James Stirling in his "Methodus Differentialis", published as long ago as 1740. Reference to the general method is welcome because, even now it seems not to be used as widely as it deserves except by Naval Architects, who have long employed it and Tchebycheff's Rules as practical methods of integration.

The other two appendices relate, respectively, to an examination of the fundamental frequency of a freely supported rod of varying section and to the effect of flexibility of propeller blades on gyroscopic couples in a turn.

The book is well printed, on good paper.
B. C. C.

Introduction to Carbohydrate Bio-Chemistry
By D. J. Bell. (Published by the University Tutorial Press Ltd., London), 1948. Pp. viii + 107. Price 6sh. net.

Though written for students reading Biochemistry for Part I of the Natural Sciences Tripos at Cambridge and as Introductory reading for Part II students, this book which discusses in a lucid and succinct manner the recent developments in the Biochemistry of carbohydrates, is worthy of being brought to the notice of students, teachers and research workers in other countries. Sir Frederick Gowland Hopkins, Late Professor of Biochemistry in the University of Cambridge, has contributed a kindly foreword.

The book is divided into eight Chapters. Chapters I-V deal with the structural formulae and the role played by simple sugars, polysaccharides, glycosides, uronic acids, nucleotides and nucleic acids. Chapter VI gives the most recent conceptions of the synthesis and breakdown of carbohydrates in Nature. This is followed by very well-written chapters on the biological liberation of energy from carbohydrates. The Chapters are amply illustrated with structural formulae of carbohydrates. The discussions of their significance in each chapter are excellent and informative. There is a bibliography at the end of each chapter of important papers for the benefit of the more advanced students.

The book can be heartily recommended to those who wish to understand the role played by carbohydrates and their derivatives in nature and obtain some background of the biochemistry of carbohydrates. Students should derive considerable inspiration from this well-thought-out and well-written book. The printing and get-up of the book show the usual finish of the University Tutorial Press.

K. V. GIRI.

Number Theory and its History. By Oystein Ore. (McGraw Hill Book Co.), 1948. Pp. 370. Price \$ 4.50.

The book provides an account of some of the main problems, methods and principles of the theory of numbers, that one would come across in his study of elementary algebra. The book is not intended as a text-book for the classroom, and although brief mention is made of several problems of a fairly advanced nature, such as primitive roots, converse of Fermat's Theorem, Euler's Theorem, and so on, the treatment is intended for those whose mathematical knowledge is limited. The treatment is however clear and precise, and within the standard contemplated leaves nothing by way of mathematical logic and outlook. The author has certainly succeeded in producing a delightful book which can not only serve as a pastime for the mathematically minded reader, but which will also be a useful book of reference to the mathematics student and teacher, up to the Honours level. An idea of the contents of the book can be had from the headings of some of the chapters: Counting and recording of numbers, Euclid's Algorithm, Indeterminate problems, Diophantine problems, Congruences, Wilson's Theorem and its consequences, Euler's Theorem and its consequences, Theory of Decimal expansions, the Converse of Fermat's Theorem.

The book is interspersed with delightful and brief historical references. In any book on the history of human achievements, the accuracy of facts depends upon the author's first-hand knowledge of diverse civilizations, and his will to be fair-minded. One can agree about the latter with regard to the present author, though it may be asked why the name of Pillai is omitted while that of L. E. Dickson is mentioned in connection with the Waring problem. But the remark, "The use of a positional system with a zero seems to have made its appearance in India in the period A.D. 600-800" cannot be passed over by any Indian, with regard to the dates. The author has taken the trouble of reading Bhaskara and Brahmagupta as depicted by Colebrooke, and does make a reference to Aryabhata. If he had gone through Aryabhata's work, he would have found that square roots and cube roots by almost the same methods as are in vogue now were known in the days of Aryabhata (499 A.D.). Some of the articles in Indian mathematical periodicals dealing with Jaina mathematics of about 500 B.C., and the treatise on the History of Indian Mathematics by Datta and Singh,—not to mention anything about Mohenjo Daro and Harappa civilization of the Indus Valley,—would enable the author to

revise his opinion about the date of the introduction of the positional system.

C. N. S.

The Physics of Music. By R. K. Viswanathan, M.A. (Published by the University, Annamalai-nagar), 1948. Pp. 135.

Carnatic music is one of the finest arts of ancient India kept alive through ages by an unbroken line of inspired teachers and their devoted pupils. In recent years, thanks to the gramophone, radio and film, Indian music has received a new impetus and attracts many votaries to its folds. A few schools and academies have sprung up in the country to impart systematic training on modern lines in both vocal and instrumental music. Though music is essentially an art which has its appeal to the emotions and æsthetic senses, its study will never be complete unless its savants understand the scientific bases of the art. The author has done signal service to the students and exponents of Indian music in bringing out in a non-technical but precise form a book dealing with the Physics of Music. The aim of the book is primarily to acquaint the reader with the fundamentals of physics bearing on the main Indian musical instruments belonging to the stringed, wind, reed, membranous and plate families. The book also deals with melody, harmony and timbre in relation to these instruments. The concluding chapters on acoustics of halls and recording and reproduction of sound give useful ideas to the lay-student about topics with which he is intimately concerned. The book is written in simple English and will be a boon to those who have chosen music as a subject of study.

C. S. V.

The Beginnings of Modern Medicine in Madras. By Dr. D. V. S. Reddy. (Thacker, Spink Co., Ltd., Calcutta), 1947. Pp. xvi + 251. Price Rs. 5.

To the many who are interested in the 'history of the growth of modern scientific medicine' in India as well as to those who are keen students of the medical institutions in Madras, this book is a valuable and welcome addition to the present scant literature on the subject. Elaborately documented with extracts from Official Proceedings of the East India Company as well as from other sources, it reveals deep and patient exploration into various published and unpublished records and wise discrimination in collecting data. The result is a book which holds the readers' interest from the beginning to the end.

Even as early as 1600 A.D., the East India Company provided two doctors and a barber to every ship that they sent eastwards. There were doctors of three grades "surgeons" with recognised training and certificate, "mates" with a few years' apprenticeship to their credit and "assistants" who had picked up some practical experience working with these professionals. It is interesting to note that even as early as 1621, East India Company told its Officials here that "India had drugs in far greater quantity, plenty and perfection than

here (i.e., England) and that they should buy them in India". They also suggested "that it is safest for the Englishmen to so comporting himself in some manner to the diet of the country".

Many of the East India Company Surgeons who had come from England were in great demand by the Princes and peoples who greatly appreciated the new system of medicine.

A regular new hospital for Madras with qualified Assistants and servants and with proper arrangements for dieting was created about the year 1713 and it was supported by Company's grants, by voluntary subscriptions and by allotting to it certain fines for offences. The Surgeons in charge were allowed to practise and receive fees. They trained assistants and certified them as fit for employment.

Some of the Surgeons in the employ of the East India Company supplemented their professional income by becoming landlords and inamdars and even by trading. The Company occasionally distributed quantities of wine and sherry for the personal use of surgeons.

The chief diseases mentioned as occurring at the time (1670-1720) among the Fort employees and their families are Venereal diseases, Scurvy and Beriberi, Fevers and Dysentery and various injuries. Among the surrounding civil population there were in addition elephantiasis and diseases incidental to maternity.

The main remedies employed were drugs, plasters and unguents supplied in medical chests and local drugs of repute that were available. Wines and liquors were rated as valuable in many complaints. Sea voyage was advised "as a general remedy for chronic ill-health".

From 1827, a regular system of training students was begun and "medical apprentices" and "medical pupils"—according as they were Eurasians or Natives were attached to Surgeons and after a long course were certified and employed.

The book gives very interesting details regarding the then Surgeons and Hospitals of Madras and many facts valuable to the students of the history of the growth of this great city of South India. The author has made a very valuable contribution to the history of the evolution of modern scientific medicine in South India. A very appreciative foreword is written by Surgeon-General J. P. Huban, I. M. S.

B. K. N.

A Hand Book of Precious Stones. By Dr. L. A. N. Iyer. (Baptist Mission Press, Calcutta), 1948. Pp. x + 188. Price Rs. 15.

In this small and attractive handbook an attempt has been made to give in popular language a general and scientific account of the properties and composition of precious stones, their occurrence, uses etc., with special reference to India wherever possible.

The first seven chapters of the book deal with the elementary facts of mineralogy that are essential for a correct understanding of the

subject. These chapters are written in extremely simple style and can be easily understood by persons who have had little scientific training. The occurrence, mining, chemical composition and physical properties of gemstones are dealt with in these preliminary chapters. The next two chapters give a general survey of the methods of gem cutting and polishing and the production of artificial and synthetic gems. The methods of differentiating natural gems from synthetic gems are also mentioned. Here the reviewer would like to point out (contrary to the statement made on p. 63) that recently star rubies and sapphires have been synthesised in America.

The second part of the book, consisting of 16 chapters, deals with the modes of occurrence, physical properties and genesis of the various gem stones such as diamond, ruby, sapphire, spinel, chrysobryl, beryl, topaz etc. The locale of occurrence of the various gemstones in India are given in great detail. The methods of mining of gems in foreign countries are contrasted with the crude ones used in India. Statistics of production and consumption in India of the different varieties of precious stones are also given. The brief accounts given about famous gems of the world together with the lore associated with them make interesting reading. The book has a useful table of physical constants of the different precious and semi-precious stones.

The reviewer feels that an addition of more text diagrams and photographs of gems would greatly enhance the usefulness of the book. Its cost also appears a bit too high for the ordinary student of mineralogy interested in gems. But the printing and binding are very satisfactory and the book would be of great value to those interested in precious stones.

S. RAMASESHAN.

The Stuff We're Made Of. By W. O. Kermack and O. Eggleton. (Edward Arnold & Co., London), 1948. Second Edition. Pp. vi+356. Price 10s. 6d.

The book under review, which is in its second edition, goes a long way towards fulfilling a keenly felt need for a popular treatise on Biochemistry, written with a clear and sure grasp of its fundamentals. The authors have shown fine discernment in marshalling the obviously endless array of facts into a pattern which is at once simple and coherent. The last chapter especially, which borders on the philosophical, is an admirable summary and review of that vast and growing science as it stands to-day.

The book has been finely got up and is profusely illustrated with many diagrams and choice photographs.

H. R.

Electrical Accidents. By K. V. Karantha, Chief Electrical Inspector to the Government of Madras. (Harsha Printery and Publications, Puttur, Madras.) Pp. iv + 136. Price Rs. 3/8.

The book has been written, according to its author 'with a view to its being of use not only to engineers but also to line inspectors, line-

men, electricians, wiring contractors, managers of factories, etc.' The use of electricity is becoming more common in the domestic, agricultural and industrial fields and therefore it is essential that all those who use it, should have some knowledge about how electrical accidents generally occur and how they can be avoided. The utility of this book is to be judged by examining how far it fulfils that purpose.

"What is the lowest voltage that can be fatal to a person" is a question commonly asked of electrical engineers but there are not many who can satisfactorily answer it. This book is therefore welcome, the more so as it gives a number of actual cases of fatal accidents due to a variety of causes.

Starting from the effect of current on the human body and the resistance of the body under varying conditions, it goes on to deal with the earthed neutral system, the tests to be made before energising an electric installation, and accidents due to negligence in adhering to regulations. Chapters IV and V deal respectively with electrical accidents in industrial establishments and in supply undertakings. Relevant provisions of the Indian Electricity rules are given wherever necessary. There are two chapters dealing with earthing and earth leakage circuit breakers, and one with fires caused by electricity. The last chapter gives us an analysis of electrical accidents. The usefulness of the book is enhanced by the appendices giving some important provisions of the Indian Electricity Act for avoidance of electrical accidents.

Though it must be admitted that most electrical accidents are due not for want of knowledge but because of deliberate carelessness and negligence on the part of the supervising staff (and sometimes of the linemen and coolies), it would be revealing for them to read this book and realise how with a little care in the proper enforcement of the rules, many accidents might have been averted and many an innocent life saved. Equally well would the consumer realise that the regulations exist not to harass him but to protect him.

Quite a number of printing and other errors have crept into the book and the language could have been better. The price is also rather high and it is to be hoped with the author that the Governments and electric supply undertakings, will consider the possibility of bringing out the more important matter contained in this book in the form of pamphlets in local languages fit for distribution to the consumers.

B. N. N.

Unesco Booklet for Science Teachers

An illustrated booklet, "Suggestions for Science Teachers in Devastated Countries", has just been issued by the United Nations Educational, Scientific and Cultural Organisation. The booklet, which shows how teachers lacking elementary scientific equipment can make apparatus from simple, everyday materials, is being distributed free by Unesco to schools in Greece, Poland, Czechoslovakia, Austria, Hungary, Italy, China and the Philippines.

Its author is J. P. Stephenson, science Master at City of London School and member of the Royal Society Committee for Co-operation with Unesco. He first explains how science teaching can be commenced without the use of apparatus and then shows how equipment for experiments in astronomy, meteorology, measurement, heat, light, magnetism, electricity, chemistry and biology can be improvised from materials such as wood, glass-tube, wire, nails, bottles and other household articles.

The booklet also touches on the use of visual aids in science teaching and includes a description of recent laboratory materials, such as plastics and alloys, as well as a section on laboratory receipts, charts and logarithm tables. Suggestions are made clear by well-drawn diagrams.

"These improvisations should not be thought of as makeshifts", the author says in a foreword. "They and the exercise of constructing them, are in the best tradition of science and science teaching. All the great scientists have used such apparatus and many have made their greatest discoveries in this way".

Unesco hopes that teachers in devastated countries will find the book helpful, not only for the concrete suggestions it offers, but also for the stimulus it gives for further improvisation in elementary science. It is possible, too, that teachers in more fortunate countries may derive useful ideas for extending the scope of their classes at little cost.

We should like to add that the publication would be found extremely useful and inspiring suggestive to science teachers in India, who are confronted with problem of finding adequate funds for imparting practical instruction in their poorly equipped laboratories.

Ministries of Education are free to reproduce the booklet in English or in translation, provided acknowledgement to Unesco is made.

Hydro-Electric Development in India. (Central Board of Irrigation — Popular Series Leaflet No. 5.)

The leaflet gives a general description of sources that constitute electric power, and the progress hitherto made in India to develop such sources. It points out that though India has a large potential of hydro-electric power in her large rivers and high mountains, estimated to be about 30 to 40 million kW, only about 0.5 million kW or 1.5% of her potential power has been so far developed.

Compared to this slow growth of hydro-electric power in India, from 0.08 million kW in 1920 to 0.5 million kW at present, there have been rapid growths in other countries, for example, in U.S.S.R. waterpower developed at present is 22.4 million kW or about 22% of her potential power compared to nothing developed in 1920. Present day, the consumption of electricity for all purposes *per capita* indicates a true measure of prosperity of a country and which is only 9.2 kW hrs. in India against 4000 in Canada, 3090 in Norway, 2100 in Sweden, 2000 in Switzerland and 1660 in U.S.A. In this connection it is interesting to record that the first hydro-electric development in India was in 1897.

Another, not too wholesome, feature of the scanty progress made in India is the fact that most of the existing installations have been planned to satisfy the demands of the urban areas. Calcutta and Bombay with a total population of 1% of the whole country, between themselves, consume half of the total electric energy produced in India leaving the other half of the power for the remaining 99% of the population; excepting in a few villages in Madras and Mysore, the amenities of electricity are unknown to the common man. Compared to this state of affairs in India, Sweden claims to have electrified 85% of her homes in rural areas.

The pamphlet brings out another important point regarding the use made of the different sources of power in India. India's resources in oil, so far as is known today, are meagre. Her wealth of coal is confined mainly to Bihar, West Bengal, and small outliers in Assam, Central Provinces and Hyderabad. The distribution is uneven and distances from coalfields to different industrial centres so great that except at or near localities where coal mines occur, power cannot be produced economically from coal. Further at the present rate of consumption, the known coal resources of the country would be exhausted in another about 100 years. The Railways in India consume about 7 million tons of coal annually, which is one-third of the total annual consumption in the country. By using large amount of hydro-electric power for traction and other purposes coal could be conserved for other more profitable uses.

The relative growth in the use in India of different sources of power for the production of electrical energy is also worth noting. While the growth in the installed capacity of thermal stations using oil and coal has been from 54.3 MW in 1920 to 852.6 MW in 1947 or about 15.7 times the growth in the capacity of hydro-electric power has been from 79.5 MW in 1920 to 499.2 MW in 1947, i.e., about 6.3 times. On the other hand, the total energy generated by hydro-electric power is greater than from steam power plants.

The leaflet discusses, in summary, the reason for the very slow growth in hydro-electric power development. Amongst many causes mentioned are the denial of freedom of action, the absence or insufficiency of machinery for initiating Central and Provincial projects, unduly expensive nature of some of the early schemes, and the system of financing public works. Except for the development in Mysore, all the early hydro-electric developments in India are the result of private enterprise. The major State-managed hydro-electric work started with the Pykara and Mandi Schemes in 1933. Details of 12 State projects now contemplated in different Provinces and States in India are given. These projects are receiving serious consideration, some of them have passed the initial planning stages and are under construction. These schemes, when completed, will add more than 14 million kW of power to the existing 0.5 million kW of hydro-electric power in India.

The leaflet apart from briefly indicating details of ambitious schemes above mentioned

for the overall progress in the economic and industrial development of the country also rightly points out the necessity of large amount of work in developing research on different branches and subjects allied to such projects and also in the manufacture of essential plant for generation, transmission, and utilisation of such a large amount of electric power.

However, with this contemplated large development of electric power, one wonders whether immediately there will be use of all the power and that the hundreds and thousands of transmission pylons over the countryside carrying bulks of power would not remain idle for a time (a large capital idly blocked up)! Therefore, in addition to what has been mentioned in the leaflet, one cannot afford to lose sight of another aspect of such development. If the common people of the country is to be benefitted by these developments it is highly important that immediate steps should be taken to educate the mass, the rural population, in the benefit and uses of electricity for the betterment of their economic and living conditions.

The other comments one might offer are that certain of the projects could do with more looking into. In certain cases it may be worthwhile to reconsider location, design, proposed nature of structure, and examine locations which might result in economic construction. Besides the now announced policy of the Government of India that only projects of a major nature would be immediately undertaken and the rest would have to be deferred to a later date, the projects and the materialisation thereof would involve a prolonged period and most of our rural areas will thus remain unserved for a long time. The development scheme must, therefore, incorporate some other planned programme which would ultimately merge into the overall picture and in the interim period help in the economic uplift. It would be worth considering setting up of small nursery power stations which would fill in the gap for a number of years till all major schemes finally materialise. These stations, when finally closed down or nearer to be closed down, apart from having served their purpose and the useful period of life, would also constitute an effective weapon; (a) for rural and agricultural development, development of cottage industries thus helping to ameliorate the economic conditions; (b) for an intensive impetus for an intensive development of manufacture of prime movers and electric plant in this country, and, (c) for the load building essential for all the projects when they finally come into being.

M. S. THACKER.

Vernalization and Photoperiodism. A Symposium. By Murneck, Whyte, et al. Vol. 1. *Lotsaya- A Biological Miscellany.* (The Chronica Botanica Company, Waltham, Mass, U.S.A.), 1948. Pp. 15 + 196. Price \$4.50.

All workers in the field of pre-treatment of crop plants will welcome the publication of this symposium, to which some of the foremost

experimenters have contributed. This is the first volume in a series planned and edited by Dr. Frans Verdoorn, and deals with the biology of flowering.

Starting with an outline of the historical background of research in vernalization and photoperiodism, the next three chapters deal with the physiology of periodicity. Hormonal relationship, the wave-length relationship and nutritional and metabolic relationship to photoperiodism are discussed. This is followed by a chapter on anatomical and histological changes induced in plants by vernalization treatments. Next, H. A. Allard discusses the evolutionary aspect of photoperiodicity, dealing with ancient climatic cycles and length of the day in the past. M. Y. Nuttonson discusses the photoperiodic and thermal requirements of crop plants as revealed by phenological observations.

The chapter on vernalization and photoperiodism in the tropics is by S. M. Sircar, and deals with work done in Indian crop plants. The practical applications of this branch of plant physiology are considered. A briefer article on internal rhythm in a few tropical plants is given by E. Bunning (in German).

Thermoperiodicity, a plant feature likely to be of great importance in tropical agriculture is briefly discussed by F. W. Went, but a certain amount of related information is given in other chapters also.

A. Lang has a note (in German) on a factorial analysis of short-day character in a strain of tobacco, a pioneer contribution to this branch of genetics.

As Kenneth V. Thimann has pointed out in the foreword, this symposium appears at an opportune moment. It presents the known facts in a cogent manner, pointing out at the same time how much more is yet unknown. Because of this able arrangement and discussion, the book will be of great use to investigators in this field, which is likely to be of value to world's agriculture.

The numerous illustrations and photographs add to the value of this book. A complete author index and a general subject index are included.

C. G.

Organic Chlorine Compounds. By Ernest Hamlin Huntress. (Published by John Wiley & Sons, Inc.), 1948. Pp. xxv + 1443. \$27.50.

Organic Chlorine Compounds is the second book in the series of *Tables of Data* by Prof. Huntress, and presents a summary of data on a selected list of organic compounds containing C, H, O, Cl, described by the author as comprising Order 3; the first two Orders are represented by compounds containing C, H, O and C, H, O, N respectively. The compounds have been arranged into three subdivisions: solids; liquids which can be distilled at ordinary pressure; and liquids which can only be distilled under reduced pressure. One thousand three hundred and twenty individual compounds have been described in detail over 1443 pages. A very valuable aspect of the book is the information

on the methods of preparation, physical and chemical properties, derivatives, references to Beilstein, and the complete literature on the compounds which has been brought up to 1947 as far as possible. The literature on the chemical reactions characteristic of the individual organic chlorine compounds is not only a record of known facts, but indicates in some cases the possibilities for future developments.

Considering the price of the book (\$27.50) it must be regarded as one for reference libraries rather than for personal possession. When judged as a reference book the value of the book is limited in view of the incompleteness of the compilation. Some omissions which were noticed are 1:4:5:8-tetrachloroanthraquinone, the chlorohydroxy-anthraquinones (including 3-chloroalizarin) and the chlorobenzanthrones. D.D.P. is mentioned by this name, but not Gammexane. The author has, however, made it clear that the book is not to be regarded as a substitute for Beilstein, and that the compounds have been selected on the basis of their importance—a heavy responsibility to undertake, since the importance of a compound must depend on one's personal interests. 1:4:5:8-Tetrachloroanthraquinone for instance is a very important dyestuff intermediate.

Classification of organic compounds on the basis of physical properties such as the m.p. or the b.p., as followed in this book, is of doubtful

advantage; and leads to considerable repetition of information regarding compounds which are on the borderline between solids and liquids. It is not often that an organic chemist starts wading through literature for compounds with a given m.p. or b.p., although such a search may prove fruitful in some cases. If the organic chlorine compounds had been classified in the manner of Beilstein, based on rational chemical relationships, the trouble of compiling several indexes, in order to facilitate the location of individual compounds in the book, might have been saved. While the formula, chemical type and alphabetical indexes are valuable, the indexes of empirical formulae according to percentage chlorine and to M.W. are less useful.

Since chlorine and the other halogens do not form part of ring systems, chlorine containing compounds can only be considered as derived from fundamental hydrocarbons or heterocyclic systems. If a separate classification is made, one which includes all the halogens would have been of more value than the compilation of chlorine containing organic compounds alone. While the basis of the arrangement of the organic chlorine compounds is open to criticism, the information on the chlorine compounds included in the book is very exhaustive and of immense assistance to research workers.

K. VENKATARAMAN.

SCIENCE NOTES AND NEWS

Draft Indian Standards for Refractories

The Engineering Division Council of the ISI has brought out three Draft Indian Standards on Fireclay Refractories. They are concerned with Moderate Heat Duty Fireclay Refractories, Group 'A'; Moderate Heat Duty Fireclay Refractories, Group 'B'; and High Heat Duty Fireclay Refractories. These have been prepared by an expert Sectional Committee composed of representatives of manufacturers and consumers of refractories in India. The Committee is headed by Dr H. K. Mitra of the Tata Iron & Steel Co. Ltd., Jamshedpur.

The drafts on refractories consist of standard specifications for different types of refractories produced in India and the methods for chemical analysis, the determination of pyrometric cone equivalent; under load for full size bricks as well as for sections of bricks, the porosity, and the determination of resistance to spalling.

The object of the specifications and tests is to provide an agreed method of evaluation of the three different types of refractories.

In accordance with the procedure of the Indian Standards Institution, every draft specification or code prepared by a Sectional Committee or Sub-Committee, after its approval by the Sectional Committee, is to be issued in proof form for a period to be deter-

mined by the Committee but not less than three months and widely circulated amongst those likely to be interested, for the purpose of securing critical review and suggestions for improvement. Comments received from all quarters shall be given due consideration by the Sectional Committee; and the revised final draft will then be put up to the Engineering Division Council for endorsement. Before being finally accepted as an Indian Standard it must be approved by the Executive Committee and the General Council of the Institution.

These drafts on Fireclay refractories have been widely circulated to industrialists and technologists in the field. Comments will be received till 29 February 1949, by the Director, Indian Standards Institution, 'P' Block, Raisina Road, New Delhi.

Unified Screw Thread System

An important step towards the standardisation of mechanical products made by Britain, Canada and the U.S.A. is an agreement which has just been reached between these three countries to standardise screw thread.

This means that machine parts of British or American manufacture will be interchangeable, an impossibility for many years because hitherto the angle of threads of screws, bolts and nuts differed by five degrees.

The common standard agreed to now will be known as the Unified Screw Thread system and the agreement as completed will establish several classes of screw threads with compromise dimensions.

The pact will greatly facilitate the sale and maintenance of mechanical products among the three countries since the replacement of parts for imported motor-cars, washing machines and hundreds of other items can be made in the buyer's own country.

German Publications

Anyone wishing to purchase books published in Germany may do so by placing his order through any bookseller, who may then apply directly to the publisher in Germany. The transaction is administered through the Joint Export and Import Agency of Military Government and payment can be made in the currency of the country in which the original order is placed. The delay in obtaining the book may be a matter of some weeks, or, of course, considerably longer if the publisher has not previously obtained a licence for export from the Joint Export and Import Agency. However, many publishers who foresee a demand outside Germany for a particular book will have obtained the required licence soon after the appearance of the book in Germany. (*By courtesy of the Principal Scientific Officer, Unesco, Delhi.*)

Indian Institute of Chemical Engineers

The First Annual General Meeting of the Indian Institute of Chemical Engineers was held on 1st and 2nd January, 1949 under the auspices of the Indian Science Congress at Allahabad.

Technical papers on six different chemical engineering problems were read by leading chemical engineers from Bombay, Calcutta, Madras, Delhi, Dhanbad and Waltair. The meeting also conducted a symposium on Chemical Engineering education.

Indian Phytopathological Society

At the second Annual General Meeting of the Society held on January 2, 1949 at Allahabad, the following office-bearers of the Society were elected: President: Dr. S. R. Bose, Vice-President Dr. R. S. Vasudeva. Councillors: Northern Zone—Dr. R. Prasada, Mid-Eastern Zone—Dr. K. C. Mehta Eastern Zone—Mr. S. Y. Padmanabhan, Central Zone (general)—Dr. M. J. Thirumalachar, Western Zone—Dr. M. K. Patel, Southern Zone—Mr. K. M. Thomas. Dr. B. B. Mundkur continues as the Secretary-Treasurer.

Lady Tata Memorial Trust

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250/- each per month for the year 1949-50 commencing from 1st July 1949. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only

and the holders must undertake to work whole-time under the direction of the head of a recognised research Institute or Laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Candidates can obtain these instructions and other information they desire from the Secretary of the above Trust, Bombay House, Bruce Street, Fort, Bombay 1.

Elliott Prize for Scientific Research

In accordance with the Government of Bengal Notification No. 1127 Edn., dated 5-5-1917, the Elliott Prize for 1949 for Scientific Research in chemistry will be awarded to the author of the best paper giving the results of original research carried out by the candidate in Chemistry and published during the years 1945-48 inclusive.

Any native of Bengal, Bihar or Orissa or any Anglo-Indian or domiciled European, residing in Bengal, Bihar or Orissa, may compete for the prize.

The reprints of papers (and not manuscripts) must reach the President of the Royal Asiatic Society of Bengal, 1, Park Street, Calcutta, by the end of June, 1949. The prize will be awarded publicly at the Annual General Meeting of the Royal Asiatic Society of Bengal in February, 1950. Preference will be given to researches leading to discoveries likely to develop the industrial resources of Bengal, Bihar or Orissa.

The prize may be in cash or partly in the form of a gold medal and partly in cash. In the event of no essay being deemed of sufficient merit, no prize will be awarded.

The prizes for the next four years will be offered as follows:—

(i) 1950 — Physics — papers to be submitted by the end of June, 1950.

(ii) 1951 — Geology and Biology (including Pathology and Physiology)—by the end of June, 1951.

(iii) 1952 — Mathematics — by the end of June, 1952.

(iv) 1953 — Chemistry — by the end of June, 1953.

All papers for competition must have been published during the four calendar years immediately preceding the year for which the prize is awarded.

Unesco Fellowship

Professor D. D. Kosambi of the Tata Institute of Fundamental Research of Bombay, has been given a UNESCO fellowship to work on the new types of electronic calculating machines, for setting up a modern calculating laboratory in Asia.

Kosambi has been invited as a visiting Professor by Chicago University. He will also visit the Institute for Advanced Study at Princeton and serve on a committee of mathematicians to select the recipients of Field Medals which will be awarded at the forthcoming International Congress of Mathematicians (Massachusetts).

U. S. Research Fellowship

Awarded a Research Fellowship by the Federal Security Agency of the U.S. Public Health Service, Dr. V. S. Waravdekar, Assistant Research Officer of the Indian Research Fund Association, Government of India, is doing research in cancer at the National Cancer Institute, Bethesda, Maryland. His special field of study is the activity of enzymes in animal tumors screened with different compounds.

Benares Hindu University

On the recommendation of an Examiners' Board of Prof. Norrish, F.R.S., Prof. Emeleus, F.R.S., Sir J. C. Ghosh, Prof. Polanzi, F.R.S. and Melville, F.R.S., Messrs J. N. Sahey, M.Sc. and S. R. Mohanty, M.Sc. received the Ph.D. of the Benares Hindu University for work on N_2O-H_2 Reaction under Silent Discharge and *Joshi-Effect* respectively.

Conference on Biological Sciences

In June, 1948, an International Conference on urgent needs and problems in Taxonomic Botany was held under the auspices of the International Union of Biological Sciences, with the aid of UNESCO, at the University of Utrecht, the Netherlands. The Conference, which was held under the chairmanship of Dr. Lanjouw of the Utrecht University Herbarium, concerned itself chiefly with the proposals, received by the Executive Committee for Botanical Nomenclature, for Consideration at the Stockholm Conference. The Conference discussed also a number of other problems and possibilities regarding more effective and closer international co-operation in taxonomic botany.

A report of the conference is in preparation. This will be published in CHRONICA BOTANICA. An advance reprint of the report will be made available in order that it can be distributed well before the Stockholm Conference.

Indian Scientists to Tour Australia

A team of Australian scientists consisting of Sir John Madeson, Sir Kerr Grant, Prof. J. S. Prescott, Mr. R. G. Thomas and Mr. G. B. Gresford visited India in January/March 1948 and were the guests of the Government of India. The result of that visit cemented the friendly relations with Australia. The Australian Government have requested the Government of India to send out a team of Indian scientists on a return visit to Australia as their guests. The Government of India have decided to send out the following team of scientists to Australia for a period of six weeks. The scientists will emplane from Calcutta for Australia on the

19th February 1949. All arrangements in connection with the visit are being made by the Department of Scientific Research.

1. Dr. S. Krishna, C.I.E., Ph.D., D.Sc., F.I.C., F.A.Sc., Director, Forest Products Research, Forest Research Institute, Dehra Dun. (Leader).

2. Lt.-Col. M. L. Ahuja, M.B., Ch.B., M.D., D.P.H., Director, Central Research Station, Kasauli. (Member).

3. Dr. B. P. Pal, M.Sc., Ph.D., F.L.S., F.N.I., Joint Director, Indian Agricultural Research Institute, New Delhi. (Member).

4. Mr. V. P. Sondhi, M.Sc., F.G.S., F.N.I., Deputy Director, Geological Survey of India, Calcutta. (Member).

5. Dr. K. N. Mathur, D.Sc., F.N.I., Assistant Director, National Physical Laboratory, New Delhi. (Secretary).

The team of scientists will tour Australia and will visit different research organisations and scientific institutes which are of particular interest to each of them. The visit of our scientists to Australia will lead to the exchange of valuable scientific information and help to strengthen the already existing ties of friendship between India and Australia.

Prof. Chapman at Ahmedabad

Professor Sydney Chapman, F.R.S., Professor of Mathematics in the University of Oxford, distinguished geophysicist, and President of the Association of Terrestrial Magnetism of the International Union of Geodesy and Geophysics, has kindly agreed to deliver a course of eight lectures in the Physical Research Laboratory, Ahmedabad, on "Geomagnetism and Related Phenomena". The lectures will be held daily and are expected to commence on the 24th January 1949.

Royal Institute of Science, Bombay

Sir C. V. Raman will deliver a series of six lectures on the Scattering of Light in Liquids and Solids beginning from January 31st, under the auspices of the Royal Institute of Science, Bombay.

Trombicula deliensis, Vector of Typhus

The Director, Institute of Hygiene, Calcutta, has sent us a telegraphic announcement under date 31st December 1948 that:

Drs. K. V. Krishnan and R. O. A. Smith after developing a technique for breeding *Trombicula deliensis* in the laboratory over several generations, have used these mites in transmission experiments with white mouse as the test animal and obtained proof that *T. deliensis* larvae are the Vectors of Typhus in Bengal. This work was carried out at the All-India Institute of Hygiene and Public Health, Calcutta, under a grant from the Indian Research Fund Association.

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[No. 2

	PAGE		PAGE
<i>A Modern Drug Industry for India</i> ..	31	<i>Sir C. V. Raman</i>	32
<i>Quality in Scientific Research</i>		<i>Modern Trends in Systematics</i> ..	39
SIR T. S. VENKATRAMAN	32	<i>Mathematical Procedure in Statistical</i>	
<i>The Asian Regional Commission of the</i>		<i>Theory</i>	40
<i>International Meteorological Organisa-</i>		<i>Improvement of Agricultural Statistics</i> ..	40
<i>tion</i>	33	<i>Letters to the Editor</i>	41
<i>The Micromanipulator.</i> S. L. SCHOUTEN ..	34	<i>Research Information Service</i>	53
<i>Bee Research Stations for India.</i> A. S.		<i>Reviews</i>	54
SRIVASTAVA AND M. SREENIVASAYA ..	36	<i>Fugitive Molecules,</i>	
<i>New Annual Review s</i>	33	S. V. ANANTAKRISHNAN	57
		<i>Science Notes and News</i>	59

A MODERN DRUG INDUSTRY FOR INDIA

THE decision of the Government of the Indian Dominion to start the production of an essential group of modern drugs—antibiotics, antimalarials and sulphas—at an estimated capital cost of two crores and a half, represents one of the most enlightened and progressive measures adopted by the National Government. The venture is a welcome contribution to the establishment of a drug industry on modern lines.

Major-General S. S. Sokhey, well known not only for his brilliant contributions to chemotherapy but also for his inspiring leadership in the creation of an active,

contented, well disciplined and enduring school of research at the Haffkine Institute, Bombay, we learn, has been largely responsible for conceiving the idea and convincing the Government of the necessity for launching upon this enterprise.

In conformity with the recent policy of the Government of India to requisition expert assistance and advice from foreign firms in the matter of establishing industries in this country, a reputed Swedish firm, according to the press reports, has been invited to tender technical advice in the design and construction of the factory.

The production as planned, is expected to take care of nearly three-fourths of the major illnesses prevalent in India and effect a substantial saving (Rs. 2.25 crores per annum) in hard currency since most of these drugs are, at the moment, being imported from the U.S.A.

We are not quite happy about the disconcerting but nevertheless inevitable time lag—the long three-year period—which is said to be necessary for starting the production of these drugs. Considering the phenomenally rapid advances which are being made in the field of chemotherapy, there is the risk of the drugs now proposed to be manufactured being superseded by superior specifics, more potent, less toxic and less expensive to manufacture. Such risks one has to face in a competitive world, but they could be considerably minimised by a careful selection of plant and equipment, thoughtfully designed and fabricated to secure adequate flexibility so that the same manufacturing machinery could be harnessed for making other drugs. In the present

instance, the plants contemplated to be installed, we hope, possess this merit.

The drugs now proposed to be produced are of vital significance to the nation and in the event of a war, these plants need adequate protection. From this point of view many may doubt the wisdom of locating the factory at Bombay, considering the imminent vulnerability of the metropolis. It would not be difficult to suggest other alternative sites for the location, e.g., Bangalore, offering greater attractions for the industry to flourish and expand. We hope and trust that the organisers of this vital industry will give due consideration to this aspect of the problem.

We look upon this State enterprise as a national asset, not merely because of the means it provides for attaining a state of self-sufficiency with respect to these essential drugs, but on account of the long-range benefits which the venture could be made to confer on the country's drug research and industry, if the industry is well planned with scientific vision and technical foresight.

QUALITY IN SCIENTIFIC RESEARCH

YOUR January issue opens with a leader "Quality in Scientific Research" basing your comments on the recent speech of our outspoken Prime Minister at the Indian Science Institute, Bangalore. He is reported to have stated that research output in our country is not commensurate with the monies expended and with the wealth of research material and human talent available in the country. You lay the blame at the door of what you call the absence of "research climate". Below are indicated certain other causes for the dearth complained of.

With few honourable exceptions the spirit of wholehearted one-pointed continued devotion to research is lacking in many of our scientists. The reasons are partly social: the young enthusiast finds himself saddled with domestic and social commitments at a time when research should occupy his sole attention. Often so-called administrative needs pick him out

of his line and place him elsewhere and this breaks the continuity and enthusiasm of the researcher.

Apparently because the spirit of modern scientific research is somewhat recent in the country, many of our scientists show a love for power and administration, both of which are inimical to true research. A brilliant agricultural scientist held sway over one of our important institutes for about a year and he was able to cut down routine administrative work of the directorate by a well-planned method of decentralization in the matter of control. Others who occupied the same position—both European and Indian—showed a regrettable tendency to gather more administrative control than necessary. Ultimately, the Government red tape with its files and unending back papers proved so stifling that he decided to quit. During his regime the scientists under him enjoyed a freedom they never had before or after.

Our scientists would do well to rid themselves of the mania for control and power to produce.

The present science departments have been modelled on the revenue-collecting departments with their graded array of heads, deputies, and assistants in descending order with great differences in emoluments. This difference in emoluments is often interpreted as connoting parallel differences in research talent which is wrong. We have not yet learned to appreciate and give the proper position to scientific talent.

In the past, the scientific services in the country lost many useful and devoted votaries because of the allurements held out by administrative positions carrying higher status and better emoluments.

Science departments should learn to appreciate and hunt for research talent wherever found. In the future set up there should be no need for a researcher to give up his line of work and get lost in administrative nullity to improve his position. Scientific talents need to be paid on a par with administrative ability and within the science department itself the differences between pay scales should be lessened. I have very intimate knowledge of one agricultural researcher who had to give up higher emoluments in a different line of work and at a different place to enable him to produce tangible results. In this case, the individual lost but the country gained immensely.

T. S. VENKATRAMAN.

THE ASIAN REGIONAL COMMISSION OF THE INTERNATIONAL METEOROLOGICAL ORGANISATION

IT is a matter for genuine gratification that the Capital city of Free India is becoming the venue for the meetings of many International Conferences. In the first Asian Regional Commission of the International Meteorological Organisation which held its session at New Delhi from the 10th to the 20th November 1948, India played a leading part. 13 Member States including the U.S.S.R. as well as observers of the U.K., the U.S.A. and the I.C.A.O. took part in the proceedings.

The Prime Minister of India who opened the session on the 10th November, rightly stressed the importance of international co-operation in Meteorology as follows :—

".....So it is a good thing that we take advantage of all these opportunities for international co-operation, not only because it is good in their particular field of activity but because they affect the larger field of human relations in the world and make people realise that after all the world is being carried on today by a great measure of international co-operation. In this context the communications system becomes more and more international and so many other branches of Science can only progress internationally."

Therefore, I welcome all the delegates who have come here and I hope that your labours will bear fruit in this particular branch of Science which is so important for human welfare as well as in the larger field of human relations."

The Director-General of the Indian Meteorological Service was elected as President and the Chiefs of the U.S.S.R. and the Netherland East Indies Weather Services were elected as the two Vice-Presidents.

The Commission appointed *ad hoc* sub-committees to go into the following very important problems of Synoptic Meteorology in the Asian Region,—

1. Net-work of surface, upper air, radio-electric, etc., observatories.
2. Tele-communications and Broadcasts.
3. Codes and Units.
4. Marine Meteorology.
5. Use of Counting Machines for Meteorological purposes.

These sub-committees some of which were presided over by members of the Indian Meteorological Service concluded their valuable work during the session and produced workable solutions of the many problems raised and agreed plans for observational net-work, inter-regional and national meteorological broadcasts, procedure relating to codes and units, etc. The Conference held 18 plenary sessions to discuss the 25 items on the agenda and passed 45 resolutions and recommendations.

The labours of the Commission have paved the way for increased co-ordination and co-operation in the field of Meteorology. It is essential that we should have the maximum co-operation and understanding with our neighbour countries for the successful prediction of weather for the

benefit of the Indian farmer, aviator, engineer and the public at large.

Apart from the problems of organisation, procedure, communication, etc., referred to above, the Commission also considered some of the important research aspects of pure and applied Meteorology. In the field of Agricultural Meteorology the Indian workers under the Director of Agricultural Meteorology at Poona have played a leading role and it is pleasing to note that the Indian Crop-Weather Scheme has been adapted for international use by the Commission. A permanent Sub-Committee on Agricultural Meteorology, with the Director of Agricultural Meteorology, Poona (India),

as Chairman, has been constituted for the Asian Region for developing and co-ordinating the work on this subject in the various countries of Asia.

Another permanent Sub-Committee on Hydrology, a subject of such vast importance for India where many multi-purpose irrigation schemes are under way, was also constituted.

It is obvious that these meetings at Delhi have been very fruitful and we congratulate both the Government of India and its Meteorological Department for the important role they have played in furthering the cause of Meteorology in the service of the Asian Region.

THE MICROMANIPULATOR

DR. S. L. SCHOUTEN

(*Hygienisches Institute, University of Utrecht*)

EARLY in February 1948, I had the pleasure of giving to Prof. M. Sreenivasaya during his stay in my Laboratory, a comprehensive demonstration of the Micromanipulator technique and its applications to problems in bacteriology and cellular physiology. On this occasion he suggested that I should contribute a note on this subject to *Current Science*; the following article has been written in response to his kind request.

The introduction of the gelatine medium by Robert Koch, represents one of the epochal landmarks in the development of bacteriological technique and has been responsible for the phenomenal advances in microbiological research during the past sixty years. This we certainly owe to the simplicity, ease and elegance of what has now come to be known as "plating method". The clarity of the medium facilitates the unmistakable location of microbes and the development of colonies as a result of their growth. No wonder that the method has remained unchallenged and is universally employed as a routine in bacteriological research.

Many workers, however, unwilling to confine themselves to routine investigation, observed that this method had certain serious limitations. When plating river water, we may be justified in assuming that by vigorous stirring of the molten nutrient medium, the individual cells would be completely separated, and the resulting colonies developed in the petri-dish, would represent integrally pure cultures. In the

case of slimy material, however, e.g., pus, blood, faeces, filthy ditch water, this assumption would not be justified. In such samples the cells adhere together, so that it is usually extremely difficult to separate them by stirring. We encounter the same difficulty with dermatomycoses. Even after pulverising with quartz powder one finds the cells adhering together in great numbers.

The investigator is often confronted with a mixture of different bacilli, from which he is obliged to isolate and examine one of them in pure culture. The "plating method" does not give him any reliable result; none of the colonies in the plate would be representative of the species he is seeking. This difficulty is experienced by all workers. Plating—I might say—is a blind method. An unknown quantity of unknown species is plated, but you never know which of them develop, neither the way of developing (only think of the lag-time!) nor the antagonistic influence of the different associates. From bacilli, found in faeces, it is often found that only one per cent. of them develop.

The inherent drawbacks which characterise gelatine or agar-agar affect the development of certain organisms, e.g., nitrifying bacteria, but such organisms are fortunately few and occur only rarely. But what is of real importance is described in the next para.

The basis of all biological work consists in the integrity of the individual. In problems of heredity, in determining vari-

ability of a given strain, the experimenter has to carefully select his organisms individually. Should such a selection be not possible, scientific research would not be considered unimpeachable. In microbiology, selection and isolation of individual cells was considered impossible and till the end of the preceding century, investigators had reconciled themselves to this state of affairs. How could it be possible to experiment with individual cells of bacilli; Yet it is the first condition to be satisfied, if one is to follow the hereditary factors and the spontaneous variability of the organism.

In 1899, I demonstrated at the Scientific and Medical Congress at Haarlem a method which I had discovered in 1897, for isolating a single cell under the microscope. This technique which was further developed and applied, formed the subject of my dissertation. Since then I have continued my researches on the micromanipulator; during the last fifty years this work has developed in a direction which renders possible the adaption in principle of the same type of investigations with micro-organisms as those practised in the domain of the more highly organised organisms.

The method of isolating is, in brief, as follows:—On a coverslip, which has been smeared with a little Tangkallak fat and then passed through a flame, a drop of the material is placed from which it is desired to isolate a cell. At a distance of about 3 mm. apart drops are placed in which it is desired to grow the pure culture. The coverslip is then placed on a moist chamber on the microscope stage. The lateral walls of this chamber are provided with a horizontal slit, closed by a viscid fluid and through which the isolation needles project into the chamber. By means of a simple mechanism the needles can turn round a support, so that their ends can touch the corner surface of the coverslip. Any mechanical shake renders it possible to do this in any part of the field. The space in the moist chamber is kept saturated with water vapour by a drop of water on the floor. The vapour condenses on the lower surface of the coverslip, and since the latter has been treated with fat, the condensation takes place in small rounded droplets, which do not coalesce. Before use the needles are sterilised by dipping their ends in sulphuric acid and in ammonia. As micro-organism to be isolated is now

sought at the edge of the so-called material drop. The needle is moved up so that the end touches the edge of the drop near the cell that is to be isolated. Then, when the needle is moved sideways, the cell with a tiny droplet will be drawn out of the large drop. This cell is now taken up in the eyelet of the needle. This eyelet is then brought down somewhat, so that it no longer touches the coverslip, and then the moist chamber is moved sideways, under a low power, so that the eyelet, by an upward movement, comes near to the edge of one of the sterile drops and deposits the isolated cell, in a small drop (about 6μ) on the coverslip. Under high power this small drop with the cell is moved into the sterile drop, in which the culture is made. This is repeated with other cells, and when all the sterile drops contain each a cell, the coverslip is placed on a moist chamber and incubated at the required temperature. If the culture drop is solid, the colony grows on its edge, and with the aid of a high power microscope, its development can be followed from the beginning. If the culture drop is fluid, the colony generally spreads itself over the whole drop.

So much for an outline of the method of isolating by means of eye-shaped needles. When pointed needles are used, the method is somewhat modified; then the material (e.g. bac., tuberculosis, granula) is smeared on the coverslip, and the cells are simply picked up. In micro-operating fine glass point needles, for bacilli, a point of about 0.2μ is used; glass knives also can be employed.

Sometimes it is considered that these manipulations require a special aptitude and practice. But with good prepared coverglasses and clean and properly made needles, the work is agreeable and not too difficult. Isolation of a bacillus and transferring in a sterile drop requires two minutes, and cutting into two of a bacillus, taking up unfolding the double-folded, takes 15 seconds.

As to the making of the needles, I know from experience that a worker, endowed with common skill, will be able to make a good eye needle after two days, on condition that he can practise under expert personal guidance.

Note.—The cost of printing this contribution has been met from a generous grant from the Indian Council of Agricultural Research, New Delhi.

BEE RESEARCH STATIONS FOR INDIA

A. S. SRIVASTAVA AND M. SREENIVASAYA

IT is customary to describe the fabulous prosperity of a country as the land flowing with milk and honey, which are universally recognised as the two essential dietetic ingredients of every well-fed people. The extent of their production and consumption may be taken as a measure of a nation's well-being. History records that India was once such a happy country: to-day the conditions as regards the supply of milk and honey are desperate and it is only the few rich and wealthy that can afford these luxuries. To the average American, the Scandinavian and the pre-war European, honey is an easily available article of diet. During World War II, Americans were encouraged to produce and consume more and more of honey in place of sugar which was strictly rationed; the wax which was a bye-product of the expanding industry found extensive employment for securing the waterproofness and corrosion resistance of certain parts of ships, aeroplanes and other implements of war. Statistical data have shown that longevity of men is largely determined by the amount of honey consumed by them. It is a matter of common experience that the queen can be reared from a worker's larva by feeding it with diluted honey (royal Jelly).

Bees play yet another useful rôle as pollinators. Apiaries in many parts of U.S.A. are, in fact, carried from orchard to orchard during the blossoming period with the active co-operation of the growers, who are often willing to defray the expenses of transportation. Recent work in Russia indicates that honey produced from bees fed on various drugs have been found to possess specific therapeutic properties.

What are then the basic requirements for building up a prosperous bee industry? How is it possible to produce more honey per hive? These are some of the natural queries that arise in our minds. Honey yields are principally influenced by the population of a colony. For instance, hives containing population at its highest yield not only more honey per hive but also per bee than hives with small population. In other words, colony population is a very important factor. The colony population on the other hand depends on the number

of brood reared or eggs laid. The number of broods are governed by the quality of the queen. A good queen lays about 1,500 eggs per day. The number of eggs laid by a queen increases with increase of colony population, comb space and abundance of supply of pollen and honey. It has been found by practice that more honey can be produced only in large colony as majority of the bees are free for field work; whereas in a small colony most of the bees are engaged in rearing of the broods. In addition to all these factors, there should be also an abundance of natural resources in the form of nectar-bearing plants.

In India the methods for honey production at the moment are disorganised, unscientific, crude and uncertain and there is practically no large-scale industry for the production of honey. Most of the honey in the Indian market is derived from the wild beehives by certain professional tribes whose traditional and intimate knowledge of the bee and its habitat may be worth acquiring. These sources are naturally fortuitous and undependable. Methods of extraction and preservation are crude and unscientific while the trade is in the hands of unscrupulous profiteers. Due to its high price, adulteration with sugar syrup and molasses is frequent.

There are, however, great possibilities of organizing the production of honey on scientific lines with a view to not only secure steady supplies, but also to increase the production of honey. Our blossoming forests and agricultural and horticultural fields offer a rich environment for the culture of honey bees. The seasonal conditions in India are more propitious than what they obtain in other parts of the world.

Apiaries require a good location. As a rule they should be situated in well-drained areas of countryside within a range of nectar-bearing vegetation. During most of the day under all weather conditions they should receive ample sunlight and at the same time they should be screened against winds by groves or trees, which may also help the bees to fly higher and thus reduce the danger or nuisance to the farmers working on the neighbouring

fields. A natural or artificial supply of water is very necessary to be located near the apiaries for the bees. Thus an apiary, set on the bank of a river in the vicinity of blossoming orchards or agricultural crops partially surrounded by trees facing the sun during morning time, can be regarded to occupy an ideal location.

Bearing these fundamentals of practical bee-keeping in mind one can easily move ahead in establishing bee research stations in order to further the research work and disseminate this knowledge among the masses. The most spectacular advances in the science and technology of honey production have been made recently in U.S.A. A deep and earnest study of the methods of research by which American scientists improved their industry and stepped up its production, will be of inestimable value in organising our methods of honey production in India. Some of the fundamental discoveries which led to the production of higher yields of honey and to the maintenance of the health and vigour of the bees are listed :

1. Species of blossoms in relation to the quality, flavour and nutritive value of honey ;
2. Ecological and other environmental factors in relation to honey production ;
3. Study of the nutritional requirements of the queen bee and the workers.
4. Two queen or multiple queen colony system ;
5. Artificial insemination apparatus ;
6. Disease control.

So far no systematic work has been carried out on Indian bees. The production of honey could be substantially stepped up by organizing research and the following represents a scheme through which a prosperous industry may be built upon a sound scientific foundation.

1. Study of the races of the bees of India —

(a) Taxonomic ; (b) Physiological.

2. Improvements in the yield of honey from a few of the promising races.

3. Domestication of wild and promising races.

4. Breeding new races.

5. Artificial insemination.

6. Multiple queen system of bee keeping.

7. Studies in the nutrition of the queen and the workers.

8. Determination of the honey producing potential of certain ecological make-ups in agricultural and forest areas.

In our subcontinent which has such a great variety of floristic compositions and climates there should be at least five bee research stations. One of them should be centrally located and should be designated as the Central Bee Station and four others in four different places under the name Northern, Southern, Eastern and Western bee regional stations. The Central Bee Station ought to be equipped with all the modern equipment, a good library and with adequate staff consisting of a Director, a Biochemist, an Insect Physiologist, a Botanist (Systematist), a Plant Pathologist, an Entomologist, two research Assistant Entomologists, two Insectary Assistants, two laboratory technicians, four fieldmen, one stenotypist and one librarian. Each of the four regional stations should include a staff of a Apiculturist, a Biochemist, a Botanist, an Entomologist, two research Assistant Entomologists, an Insectary Assistant, two laboratory technicians, two fieldmen, a stenotypist and a librarian.

Every year, each of the four bee regional stations should hold a demonstration to popularise the means and methods of this industry among the masses. Adequate information and help ought to be given to those, who feel interested and may like to raise apiaries in their gardens, fields, or orchards.

Note — The cost of printing this article has been met from a generous grant from the Indian Council of Agricultural Research, New Delhi.

NEW ANNUAL REVIEWS

THE organization of four new Annual Reviews to be published under the auspices of Annual Reviews, Inc., is announced. The first volume of each is to appear in 1950. The preliminary organization is now complete and meetings of the Editorial Committees are to be held in the immediate future.

(a) *Annual Review of Medicine*—Editor: W. C. Cutting, Stanford University. Associate Editor: H. W. Newman, Stanford University. Editorial Committee: A. Blalock, The Johns Hopkins Hospital; J. S. L. Browne, Royal Victoria Hospital, Montreal; A. M. Butler, Harvard Medical School; E. MacKay, The Scripps Metabolic Clinic, San Diego; S. C. Madden, Emory University.

(b) *Annual Review of Physical Chemistry*—Editor: G. K. Rollefson, University of California. Associate Editor: N. E. Powell, University of California. Editorial Committee: H. Eyring, University of Utah; G. Glockler, State University of Iowa; W. F. Libby, University of Chicago; J. W. Williams, University of Wisconsin; E. B. Wilson, Jr., Harvard University.

(c) *Annual Review of Plant Physiology*—Editor: D. I. Arnon, University of California. Editorial Committee: D. R. Goddard, University of Pennsylvania; P. J. Kramer, Duke University; A. E. Murneek, University of Missouri; M. W. Parker, Bureau of Plant Industry, USDA; K. V. Thimann, Harvard University.

(d) *Annual Review of Psychology*—Editor: C. P. Stone, Stanford University. Associate Editor: D. W. Taylor. Editorial Committee: J. E. Anderson, Institute of Child Welfare, University of Minnesota; J. G. Darley, University of Minnesota; C. H. Graham, Columbia University; C. I.

Hovland, Yale University; J. G. Miller, University of Chicago.

The Editorial Committees of each of the Reviews meet annually to select the topics and authors of succeeding volumes.

It is intended that in the new Reviews the editorial policies which govern the *Annual Review of Biochemistry*, the *Annual Review of Physiology*, and the *Annual Review of Microbiology* will obtain. The subject-matter of each annual volume will consist of critical appraisals of the research proceeding in the major divisions of the field. Subjects of greatest activity will be reviewed annually, while those of lesser activity, together with any topics which encompass small divisions of the field, will be reviewed biennially. The international character of the existing Reviews will be extended into the new Reviews. It is anticipated that the fifteen or twenty authors selected for each volume will be drawn from various parts of the world in which outstanding research in the subject in question is proceeding.

Annual Reviews, Inc., is a nonprofit corporation which was first constituted in 1932 to publish the *Annual Review of Biochemistry*. Since then it has initiated the *Annual Review of Physiology* (jointly with the American Physiological Society) and the *Annual Review of Microbiology*. The members and Directors of Annual Reviews, Inc., consist of H. J. Almquist, F. E. Booth Company, Inc., Emeryville, California; H. A. Barker, University of California; H. J. Deuel, Jr., University of Southern California; J. F. Fulton, Yale University; D. R. Hoagland, University of California; J. Murray Luck, Stanford University and H. A. Spoeher, Carnegie Institution of Washington, Stanford, California.

SIR C. V. RAMAN

SIR C. V. RAMAN, the celebrated physicist, who has returned to India after visiting Europe and the U. S. A. was invited to attend an "International colloquium" at Bordeaux organised by the "Central National de la Recherche Scientifique" to celebrate the 20th anniversary of the discovery of the Raman Effect. His personal contribution at the colloquium was two reports, one on the scattering of

light and the other on the dynamic reflections of X-rays. He also attended another international conference at the University of Paris convened to discuss the electronic theory of molecule formation and of the solid state.

Sir C. V. Raman also visited Belgium, the U. K. and the U. S. A. He was warmly received and was a guest of honour at meetings of learned Societies where he

addressed scientific gatherings, visited important centres of research, renewed his personal contacts, and discussed subjects of common interest with such eminent scientists as Prof. Devaux, Sir Charles Darwin and Prof. Charles Mennebeck.

At Washington he visited the departments of the National Bureau of Standards and met several heads of the Bureau. He actively participated at the General Assembly of the International Union of Crystallography at Harvard University and gave a lecture on the theory of the vibration spectra of crystals.

In New York he met Dr. Winston E. Kock and witnessed several experiments such as "focussing of short electric waves by

metallic lenses," demonstration of the "visible speech apparatus" developed by the Bell Telephone Company and also the New Invention of the transistor intended to replace the thermionic valves in wireless. He also studied the collections of crystalline minerals in the American Museum of Natural History and saw the remarkable effects exhibited by the luminescent minerals at Franklin and New Jersey. The itinerary included a visit to the Brooklyn Polytechnic Institute where he met Prof. Hermann Mark and Prof. Fanktchen.

During his stay in the U.S.A., Sir C. V. Raman contributed a monograph on "Diamond" for publication in the Encyclopedia of Commercial Technology published by Inter-Science Publishers.

MODERN TRENDS IN SYSTEMATICS*

SYSTEMATICS is that ground-discipline of Biology which concerns itself firstly, with the orderly arrangement of the living world into a convenient and, as far as possible, natural system of hierarchical categories such as orders, families, genera, and so forth; secondly, with the distinguishing of one form or species from another, in the gamut of millions of species, both living and extinct; and thirdly, with the elucidation of the mechanisms by which these distinctions arise in nature. Systematics is sometimes also called 'Taxonomy', a term which merely means the disposition of things in a rational and lawful manner.

It was recognized early in the history of science that the lowest easily recognizable systematic unit is the species. And the problem that framed itself in the minds of scientists was how to name these millions of living species so as to avoid confusion when mentioning one or the other. This knotty problem was solved in the middle of the 18th century through the genius of the Swedish botanist, Carl Linnaeus, who invented the 'binominal' system of nomenclature. According to it, each species is written with two names—the first the generic, and the second the specific—in much the same way as our own surnames and 'christian' names respectively, with this important difference that our names refer to individuals and not to the species. Thus, the tiger is named *Felis tigris*, the leopard *Felis pardus*, and

the jungle cat *Felis chaus*—*Felis* being the generic name for all these members of the cat-family Felidae. Man's name is *Homo sapiens*. By international agreement, the following procedures find universal acceptance: (i) Within the same genus, one specific name can be employed for one species only, the name proposed earliest being the one accepted (rule of priority), so that one specific name can refer to one species and one only. (ii) The 10th edition of Linnaeus's *Systema Naturae*, published in 1758, is taken as the starting point for names of animals. (iii) The specific and generic names are latinised, and are written in the Roman script.

Later, when it was found that 'species' are not fixed but evolving, and that it is possible to recognize systematic units lower than the species, systematics was gradually transformed from a static into a dynamic discipline. The present Address deals principally with the modern dynamic trends of development during the last 30 years. The chief achievements of this period consist briefly of the following: Firstly, a large number of intraspecific systematic categories have been recognized, such as subspecies, races, forms, varieties, pure lines, and so forth. Secondly, it is now clear that species are generally made up of a number of these lower groups or

* Abstract of the Presidential Address delivered by Major Dr. M. L. Roonwal, to the Section of Zoology & Entomology, Indian Science Congress, Allahabad, January 1949.

complexes (form-groups, race-groups, etc.). Thirdly, modern systematics now plays a most significant role in the study of the mechanisms of 'speciation', by which term we mean those phenomena which are concerned in the origin of new species and subspecies. Among the most important of these mechanisms is the recently found statistical effect of population size on the

intensity of speciation. Thus, it has been shown that new species will arise most rapidly in a population which is of intermediate size and is divided into a number of smaller, partially isolated population-groups. Lastly, the great practical importance of systematics is discussed, and some suggestions are made for the future development of that discipline.

MATHEMATICAL PROCEDURE IN STATISTICAL THEORY*

THE Presidential Address is an exposition of the basic elementary mathematical principles underlying the theory and application of statistical methods.

Experiments in any field of human activity yield values of a number of variables— x_1, x_2, \dots, x_k . In a k -dimensional Euclidean space the results of observation can be denoted by a finite number of points. The totality of all possible observations will give an infinite set of points. This infinite set is unknown and statistical theory aims at the study of this set—the unknown population through the observed finite subset which is ordinarily called the sample.

A mathematical approach to this study is to assume the existence of a distribution function. The parameters of this function will epitomise all relevant characteristics of the population estimates of these parameters can be calculated as functions of the observed set and the behaviour of these estimates in the long run of experimental evidence can be studied with the help of their sampling distributions.

In this connection, two remarkable results—the Law of Large Numbers and the Central Limit Theorem—which are the outcome of extremely delicate mathematical reasoning, have given elegance and wide applicability to statistical technique. The Central Limit Theorem gives the Gaussian Normal Error Law as the dominant term in the distribution of any statistic when the number of observations is large.

The approach to normality of a large class of distribution functions has made the theory of quadratic forms and matrix algebra very important in statistical analysis. Further, the theory of approximation in the sense of Least Squares and the corresponding geometrical symbolism are also indispensable to the statistician.

* Abstract of the Presidential Address delivered by Prof. U. S. Nair, to the Statistical Section of the Indian Science Congress, Allahabad, January 1949.

IMPROVEMENT OF AGRICULTURAL STATISTICS

NECESSITY for improvement in the methods of collection of data on agriculture, particularly on yield of principal crops, existed from a long time in India. Lack of accurate figures has made it difficult to judge the degree of success of several development schemes, particularly schemes connected with 'Grow More Food'.

The fact that Random Sampling method is reliable for collection of accurate data was

known from a long time and its practicability has now been recognised by the Advisory Board of the Indian Council of Agricultural Research.

At the suggestion of the Advisory Board, all Provinces of India will take up this method. The main objects will be to estimate the yield per acre for the Provinces as a whole and to fix the district normal yields for important crops.

LETTERS TO THE EDITOR

	PAGE		PAGE
<i>On the Completely Unbiased Character of Tests of Independence in Multivariate Normal Systems</i> —R. D. NARAIN ..	41	<i>The Preparation of Transparent Jellies of Aluminium Molybdate</i> —S. P. MUSHAN ..	48
<i>New Band Systems of the TiCl Molecule</i> —P. TIRUVENGANNA RAO ..	42	<i>Chemical Investigation of the Steels of Jatopha curcas Linn.</i> —C. M. DESAI AND M. T. VYAS ..	49
<i>The Emission Spectrum of Bismuth Iodide</i> —P. TIRUVENGANNA RAO ..	42	<i>The Dinitration of Meta-Chloracetanilide</i> —B. B. DEY, R. KRISHNA MAJUMDAR AND B. R. PAI ..	49
<i>Pleochroic Halo from the Chota Nagpur Granite</i> —M. S. DORAISWAMI ..	42	<i>Preliminary Antimalarial Screening Tests of some Biguanide Derivatives</i> —I. L. BAMI, S. NITAJAN, A. S. RAMASWAMY, N. N. DE, B. H. IYER AND P. C. GUHA ..	50
<i>Berek's Compensator</i> —P. R. J. NAIDU ..	43	<i>Influence of Hydroxycarboxylic Acids on the Reaction Between α-Naphthylamine and Dichromate and α-Naphthylamine and Vanadate</i> —M. NARASIMHA SAstry AND J. V. S. RAMANJANEYULU ..	52
<i>Electrolytic Preparation of Azo Dyes II.</i> —V. V. RAMAN, AND M. V. SIFARMAN ..	44	<i>A Preliminary Investigation into the Viability of Immature Embryos of Corn under Conditions of Cold Storage at Freezing Point</i> —P. UTHAMAN ..	52
<i>A Preliminary Note on Diseases of Gram</i> —S. C. DAS AND D. P. MOHARAMANI ..	46		
<i>Alkali-Sensitive Linkages in Irradiated Cellulose</i> —T. S. A. PADMANABHAN, L. R. SUB. P. F. E. MANN, S. K. RANGANATHAN AND T. S. SUBRAMANIAN ..	47		

ON THE COMPLETELY UNBIASED CHARACTER OF TESTS OF INDEPENDENCE IN MULTIVARIATE NORMAL SYSTEMS

To prove the unbiased character of likelihood ratio tests like the test of significance of the multiple correlation coefficient or Hotelling's T^2 test, Daly (1940) used the non-null frequency distributions of these test criteria. This leads to obvious difficulties when tackling the general regression problem and the test of independence of several sets of variates, and Daly (1940) has shown only their locally unbiased character.

This paper demonstrates an approach which does not require an explicit knowledge of the frequency distribution of the test criteria, and it has been possible to prove that the likelihood ratio test for the general regression problem and the Wilk's criterion for independence of sets of variates, are completely unbiased.

As the simplest demonstration of the procedure which is applicable generally, consider the t -test for the significance of the mean of a

normal population. Let the frequency function of a sample of size n be

$$(2\pi V)^{-\frac{n}{2}} e^{-\frac{1}{2V} \sum_{i=1}^n (x_i - m)^2} \prod_i dx_i,$$

The region W — w complementary to the critical region w for testing the hypothesis, $m=0$ is given by

$$x^2 \leq K^2 \bar{x}^2,$$

where K^2 is a positive constant depending on the size of the critical region and

$$n\bar{x} = \sum_i x_i$$

$$x^2 = \sum_i (x_i - \bar{x})^2.$$

We write

$$I(m) = \int_0^{\infty} \int_{-K\bar{x}}^{K\bar{x}} e^{-\frac{n}{2V} (\bar{x} - m)^2} d\bar{x} \left[f(x^2) d(x^2) \right]$$

where

$$f(x^2) d(x^2)$$

is the frequency function of x^2 which is distributed independently of \bar{x} . To show that the test is completely unbiased is equivalent to showing that

$$I(m) \leq I(0)$$

We have

$$\frac{\partial I}{\partial m} = \int_0^{\infty} \left\{ e^{-\frac{n}{2V}(k\chi+m)^2} - e^{-\frac{n}{2V}(k\chi-m)^2} \right\} f(\chi^2) d(\chi^2)$$

which is positive or negative according as m is negative or positive. Therefore

$$I(m) \leq I(0).$$

The completely unbiased character of the E^2 -test (Tang, 1938), by stating the problem in its canonical form and following the above method of argument, can easily be shown to follow from the complete unbiasedness of the t -test just proved. This chain of reasoning can be followed up to show the completely unbiased character of the likelihood ratio test for the general regression problem and then further of the Wilk's criterion.

Detailed proofs will be published elsewhere.

Indian Council of Agric. R. D. NARAIN.
Research.

New Delhi,
December 28, 1948.

Daly, J. F., "On the unbiased character of likelihood ratio tests for independence in normal systems," *Ann. Math. Stats.*, 1940, **11**, 1. Tang, P. C., "The power function of analysis of variance tests with tables and illustrations of their use," 1938, **2**, 126.

NEW BAND SYSTEMS OF THE TlCl MOLECULE

EXCITING the vapour of thallium chloride in a high frequency discharge through a continuously evacuated pyrex tube, two new systems of bands, one between λ 4300— λ 4150 and the other between λ 4150— λ 3800 have been obtained in addition to the band system around λ 3200 analysed by Howell and Coulson.* The more refrangible system consists of about 75 bands in all which are degraded in either direction, while a few of them are headless and diffuse. The other system consists of about 18 bands which are mostly degraded towards the red, though a few of them are violet-degraded. The vibrational analyses of these two systems have shown that the lower state, which is found to be common to both of them, is the upper state of the ultraviolet system $^31-^1\Sigma$, established by Howell and Coulson. Predissociation similar to that found in the upper state of the ultraviolet system, is observed in the lower state of both the systems at $v'' = 5$. The following vibrational constants

have been determined for the more refrangible system.

$$\nu_e = 24683.3 \quad \omega_e' = 101.3 \quad \omega_e'' = 206.5 \\ x_e' \omega_e' = 0.1 \quad x_e'' \omega_e'' = 6.5$$

The locus of intense bands in this system falls on a Condon parabola which is to be expected with such relative values of ω as occur here. The following constants are suggested for the other system.

$$\nu_{0,0} \sim 24040 \quad \omega_e' \sim 100 \quad \omega_e'' \sim 205$$

The chlorine isotope effect observed in the system supports the vibrational analysis.

The close proximity of these two systems suggests that the upper levels may form an electronic doublet.

Details will be published elsewhere.

Andhra University, P. TIRUVENGANNA RAO,
Waltair,
January 2, 1949.

* Howell and Coulson, *Proc. Roy. Soc.*, 1938 **166**, 238.

THE EMISSION SPECTRUM OF BISMUTH IODIDE

A NEW BAND system between λ 5900— λ 5650, attributed to the diatomic molecule, BiI, is recorded in emission in a high frequency discharge, in addition to the band system with origin at $\nu = 23388.9$ cm.⁻¹, reported by Morgan.* Vibrational analysis of this system has led to the determination of the following vibrational constants.

$$\nu_e = 17216.0 \quad \omega_e' = 195.0 \quad \omega_e'' = 167.9 \\ x_e' \omega_e' = 1.0 \quad x_e'' \omega_e'' \sim 0.3$$

By analogy, this system may correspond to the low frequency system observed in the other bismuth halides.

Details will be published shortly.

Andhra University, P. TIRUVENGANNA RAO,
Waltair,
January 19, 1949.

* Morgan, *Phys. Rev.*, 1936, **49**, 47.

PLEOCHROIC HALO FROM THE CHOTA NAGPUR GRANITE

WHILE consulting literature regarding the occurrences of pleochroic haloes in minerals, the description of a pleochroic halo mentioned by Dr. L. A. N. Iyer¹ in granite from Chota Nagpur was noticed. He records, "In one of the crystals of biotite in the granite from south of Jatiba, a good pleochroic halo is present with a dark red grain in the centre, which is presumably zircon. It shows an inner lighter

ring and an outer darker ring." He then cites the measurements by Joly² and says, "The radius of these haloes vary only between 0.0152 mm. and 0.0160 mm., in Europe in rocks of pre-Cambrian age; whereas the halo above referred to in the Chota Nagpur granite has a radius of 0.030 mm., nearly double that of those recorded in European rocks." He has explained that it would be a thorium halo.

Referring to Joly's paper³ we find that the dimensions of haloes which he has attempted to compare with progressive geological aging is that of the primary uranium haloes. These correspond to alpha-particles which exhibit maximum of ionisation in air at a distance of 2.2 c.n. This primary uranium halo represents the earliest stage in the development of pleochroic haloes.⁴ In fully developed normal haloes where we find a series of concentric rings, the outermost radius in the case of the uranium haloes corresponds to the alpha-particles from RaC. The measurements on this as given by Joly in his paper gives an average of 0.032 mm. The rings formed as a result of the disintegration series of the thorium family give measurements in thiotite as 0.041 mm.; 0.026 mm.; 0.011 mm., etc.

From the description and the microphotograph of the halo in the Chota Nagpur rock, it appears that it is a normal halo of the uranium series and that the outermost ring as is to be expected corresponds to the range of alpha-particles from RaC and hence measures about 0.030 mm., as recorded by Dr. Iyer. The simple explanation that it represents RaC of the uranium series fully satisfies the measurements.

Geology Department, M. S. DORAISWAMI.
Anand University,
Waltair,
January 11, 1949.

1. *Rec. G.S.I.*, 1931, 65, 500. 2. *Proc. Roy. Soc., Ser. A*, 102, 682, et seq. 3. *Ibid.*, p. 694. 4. *Phil. Trans. Roy. Soc., A*, 217, 51 et seq.

BEREKS' COMPENSATOR

THERE is an impression that, if the tables supplied by the makers of the Berek's compensator is lost, the compensator cannot be used. Rogers and Kerr¹ remark, "the value is inserted in a simple formula supplied by the makers of the instrument. Solution of the formula gives the correct retardation for the mineral grain." This might be interpreted to mean that the formula is that of the makers, and that there-

fore the tables supplied by them are necessary for its use. This is not so. The formula given by the makers is—

$$\log \Gamma = C + \log f(i).$$

This is a method of solving by logarithms the well-known formula for retardation; $\Gamma = C \times f(i)$ or $R = K \times D$ (given by Johannsen for the use of the Babinet compensator)² where Γ or R = retardation of the mineral to be determined, C or K = the constant of the Berek's compensator determined on any microscope, and $f(i)$ or D , the reading of the drum of the compensator for any mineral, whose birefringence is to be determined.

If the tables are lost, the procedure is:—

The Berek's compensator is calibrated for white light by reading the divisions on the drum from the first order violet on the one side of the black cross to the first order violet on the other side. Say the readings are 44.2 and 15.1. Then 44.2 minus 15.1 divided by two = 14.55 = $\lambda = 550 \mu\mu$ (the wavelength of white light). Therefore the constant C or $K = \frac{550 \mu\mu}{14.55}$.

The mineral (say hypersthene) is then placed on the stage and turned 45° from the position of extinction with its C-crystallographic axis \perp to the long direction of the compensator, and the drum read from the dark bar of compensation on the one side to the dark bar on the other. Say the readings are 54.7 and 4.8. Therefore $f(i)$ or $D = 54.7$ minus 4.8 divided by two = 24.95. Applying the general formula for retardation, Retardation of hypersthene Γ or $R = C$ or $K \times f(i)$ or $D = \left(\frac{550 \mu\mu}{14.55}\right) \times 24.95$, and solving by logarithms,

$\log \Gamma$ or $R = \log 550 + \log 24.95 - \log 14.55$, using Clarkes' tables, Γ or $R = 943.2 \mu\mu$.

Birefringence $(n_2 - n_1) = \frac{R}{M}$, where R = retardation and M = thickness of the section.³ The thickness of hypersthene is measured by a micrometer screw. In this case it is 0.06 mm., which is expressed in $\mu\mu = 60000$. Therefore birefringence of hypersthene is $\frac{943.2 \mu\mu}{60000 \mu\mu} = 0.0157$.

(The microscope used in this case is Leitz 313769 with objective P_3 and ocular $P_1 5\times$).

Central College,
Mysore University,
February 10, 1949.

P. R. J. NAIDU.

1. Rogers, A. F. and Kerr, P. F., *Optical Mineralogy*, 1942, p. 77. 2. Johannsen, A., *Manual of Petrographic Methods*, 1918, p. 375. 3. *Op. cit.*, p. 370.

ELECTROLYTIC PREPARATION OF AZO-DYES-II

A. Effect on Dye Yield of Duration of Electrolysis

The mechanism of the formation of azo-dyes at the anode in an electrolytic cell was discussed in an earlier communication.¹ It was observed that hydroxyl ion discharge at the anode is likely to interfere with the discharge of nitrite ions, so that the chances of the amine getting diazotised with 100% current efficiency were remote. If this were true, a good deal of nitrite would be left unreacted at the end of a run during which only the theoretical quantity of current had been passed. A higher yield of the dye should therefore be obtained if the current were passed for more than the theoretical period of time. This was found to be so. The electrolysis was carried out under the same conditions as before, but the current was passed for thrice the time theoretically required, at a current density of 5 amps./dm.² The yield of dye was found to be better, and there was no deterioration either in the colour of the dye or in the shade produced by it on silk. Yield of dye: 2.4 gm. or 48% of the theoretical.

It is interesting to mention at this point that Brockman and Griffin² report a similar observation in connection with the electrolytic preparation of another dye, Orange II. On investigation, qualitative agreement with their observation was noticed, but as with Roccelin, it was not possible to secure the same yield of dye that they claim.

A mixture of sulphanilic acid (2.5 g.), β -naphthol (1.8 g.), sodium hydroxide (0.8 g.), and sodium nitrite (1.0 g. in 150 cc. of water), were electrolysed for the theoretical length of time. The current density employed was 5 amps./dm.² After the electrolysis, the dye was precipitated as the barium salt by the addition of barium chloride solution, filtered washed and dried. Yield of dye: (Ba salt) 1.55 g. or 31% of the theoretical.

Brockman and Griffin claim to have obtained this dye in 46.8% yield, and better still, i.e., 67.7% when twice the theoretical amount of current had been passed.

This claim could not be verified. On passing the current for three times the theoretical length of time, other conditions remaining the same, the yield of dye improved but amounted only to 2.77 gm. of the barium salt, or 55.4% of the theoretical yield.

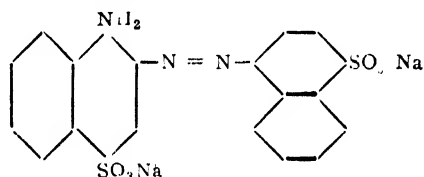
The dye had a good red colour, and the colour on silk was quite pleasing and compared very

favourably with the shade produced by Orange II prepared in the usual way.

B. Preparation of Congo Red

The study of disazo-dyes has a twofold interest. In the first place, this group of dyes, headed by Congo Red, forms the commercially well-known group of dyestuffs known as the direct cotton dyes, on account of their ability to produce good, fast shades on cotton fabric without the aid of mordants. Secondly, it is generally not so easy to prepare these dyes as it is to prepare mono-azo dyes. For one thing, tetrazotisation (i.e. diazotisation of both the amino groups) of the benzidine base is difficult, and then, the velocity of the coupling slows down to a very great extent when one of the two diazotised groups has coupled.

Brockman and Griffin (*loc. cit.*) who have studied the formation of Congo Red in the electrolytic cell, report an additional complication. After electrolysis the proper components in the manner already described at a platinum anode, they state that instead of the anticipated Congo Red, a dye of the structure:



was formed through the partial diazotisation of the sodium naphthionate and coupling with unreacted naphthionate; Congo Red being obtained only in minute amounts. They therefore contradict the claim made by Löb³, that Congo Red could be got by electrolytic methods.

This problem was considered worth study, since the practical value of a good method of getting direct cotton dyes by electrolytic methods already outlined cannot be underestimated.

Since the most important aspect of the problem is the tetrazotisation of benzidine, a coupling component that is unlikely to interfere with this step in the formation of the dye had to be used. The closest analogue to sodium naphthionate is the sodium salt of Neville-Winther's acid (1,4-naphthol sulphonie acid). There is no risk of interference from the coupling component to the tetrazotisation of benzidine, if this acid were used, since there are no amino groups in it.

EXPERIMENTAL

The cell employed for the electrolysis has been already described.¹ Neville-Winther's acid

(2.8 g.), benzidine (1.15 g.), sodium hydroxide (0.5 g.), and sodium nitrite (0.9 g. in 150 c.c. of water), were electrolysed at a current density of 5 amp./dm.² The anolyte did not develop any colour, even when the temperature was raised to 65°-70° C. A purple colour developed, however, when the run was repeated after adding twice the amount of sodium hydroxide (1.0 gm.). After the current was passed for the theoretical time, the anolyte was cooled and filtered in order to remove the unreacted benzidine. The filtrate was saturated with sodium chloride, and the dye separated as a flocculent precipitate. This was filtered at the pump, redissolved in a small quantity of water (50 c.c.) and salted out carefully, with good stirring, till the separation of the dye appeared to be complete. This procedure was followed in order to remove a small proportion of the sodium salt of Nevile-Winther's acid which was also precipitated in the first stage. The precipitated dye was then filtered at the pump, sucked as dry as possible, dried in the air-oven and weighed.

Yield: 1.10 gm. or 25.7% of the theoretical. This dye gave a lilac shade on cotton dyed from a slightly alkaline bath.

It was felt that Congo Red could be obtained by employing the same conditions. The interfering reaction of sodium naphthionate could not of course be entirely suppressed; but some Congo Red was likely to be formed at the same time. This expectation was realised. The experiment was carried out with sodium naphthionate (3.06 g.), benzidine, (1.15 g.), sodium nitrite (0.87 g.), and sodium hydroxide (1.00 g. in 150 c.c. of water). The conditions of electrolysis were the same as those already described for the previous preparation. The temperature was 60°-35° C. At the end of the run, the red coloured anolyte was cooled and filtered. The filtrate was boiled with 5 gm. of freshly ignited magnesium oxide for 20 minutes, cooled and filtered. The filtrate had a dark red colour, and on evaporation gave a reddish black powder which was very hygroscopic. This powder dissolved in water to give a red solution, which on treatment with dilute sulphuric acid turned purple, and a precipitate slowly formed. Filter-paper dipped in this solution turned red in colour, which became purple when touched with a drop of dilute sulphuric acid. This colour was entirely different from that given by Congo Red test paper. Evidently this powder was the dye reported by Brockman and Griffin, namely, 1-amino-1', 2'-azo naphthalene disulphonic acid-4,4',

The residue was a chalky red powder. This was boiled with a small quantity of strong sodium carbonate solution in order to bring into solution any Congo Red that might be present as the magnesium compound. The reaction appeared to be very slow and only partial. The sodium carbonate solution was therefore removed and the residue transferred to a small beaker and treated with sufficient hydrochloric acid to neutralise the magnesium oxide completely. A very dark blue, almost black precipitate immediately formed. This was rapidly filtered at the pump, transferred to a beaker again and treated with a slight excess of sodium carbonate solution. A red coloured solution was obtained from which a dark red precipitate was formed on saturating with sodium chloride. This was filtered, sucked as dry as possible and then dried in the air-oven. A dark red powder which dissolved readily in water to give a brownish red solution was got. Filter-paper dipped in this solution had a bright red colour and turned blue when touched with a drop of dilute sulphuric acid. Cotton dyed from a slightly alkaline bath with this dye had a bright red colour, while silk and wool took on a brownish red shade. Yield of dye: 0.6 gm. or 14% of the theoretical. This dye is Congo Red, more or less pure.

This figure provides an interesting contrast to the yield when Nevile-Winther's acid was employed as the coupling component, and enables a rough idea to be gained of the extent to which the diazotisation of sodium naphthionate proceeds side by side with the tetrazotisation of benzidine.

It was not possible to improve the yield of dye by altering the conditions. An increase in the amount of alkali merely reduced the yield and no dye at all was formed in an excessively alkaline anolyte. Factors such as current density and temperature had no influence on the course of the reaction.

This method of preparing benzidine dyes is therefore restricted to such types where the coupling component has no diazotisable amino groups.

Presidency College,
Madras,
November 1, 1948.

V. V. RAMAN.
M. V. SITARAMAN.

1. Sitaraman, M. V., and Raman, V. V., *Curr. Sci.*, 1948, 17, 234.
2. Brockman and Griffin, *Trans. Amer. Electrochem. Soc.*, 1939, 75, 216.
3. Löb, *Z. Elektrochem.*, 1904, 10, 237.

A PRELIMINARY NOTE ON DISEASES OF GRAM

THIS preliminary note deals with aspects of mineral nutrition of gram. From an examination of the gram plants of the Indian Agricultural Research Institute Farn in 1946-47 it was found that the diseased plants exhibited the following symptoms: (1) Top Yellowing, (2) Bottom Yellowing, (3) Yellowing and Bronzing, (4) Bronzing. A brief description of the above symptoms is given below. The disease was sporadic in distribution.

(1) *Top Yellowing*. As the name implies, the growing tips of the gram plants turn yellowish which are bleached to cream colour with age. It reduces the growth of the plants and consequently the yield suffers. The yellow colour disappears at about the time of flowering.

(2) *Bottom Yellowing*. The lower leaves first turn yellowish and progressively the top ones are affected. As the disease advances the plants show folded drooping leaves. Premature shedding of leaves also results.

(3) *Yellowing and Bronzing*. The symptoms of the disease at the early stage start with the bottom leaves. The colour is intermixed showing both bronze and yellow in the same leaflet. The top leaves show marginal bronzing in the beginning and later on the entire leaflets turn bronze. Thus while bottom leaves show both yellowing and bronzing, the top leaves show only bronzing.

on the base of the leaflet and finally on the rest of the leaflet. Among other features of the disease are retarded growth, dwarfing of the plants and decreased number of branches. Except in the case of "Bottom Yellowing" where fungal organism was found, the others were free from pathogenic organisms.

RESULTS AND DISCUSSION

The results of the chemical analysis of the healthy and diseased sample are given in the table. In this work the whole shoot was selected for analysis and each sample was composite of five healthy and diseased plants respectively, chosen at random. Three composite samples, each healthy, were also analysed.

The diseased plants in general seem to show a deficiency of boron as compared to healthy ones. Silica content in all the diseased plants is more than those of the healthy ones, the SiO_2 content being most marked in that of the "Bottom Yellowing". Other features of the nutritional disturbances as revealed through chemical analysis are given below.

Top Yellowing. The content of Mn is markedly less than that of healthy plants, the figure for the diseased being 63.6 p.p.m. and that of healthy being 153.5 to 101.3 p.p.m. Ash and P_2O_5 content is also higher than those of the healthy. There seems to be more iron and probably more molybdenum in diseased samples as compared to healthy ones.

TABLE I

Description of the sample	*Ash %	SiO_2 %	P_2O_5 %	K_2O %	CaO %	MgO %	B p.p.m.	Mn p.p.m.	Fe p.p.m.	Mo p.p.m.
1 Top yellowing. (D)	10.6 (h)	10.6 (h)	1.01 (h)	3.26	3.22	0.77	28.6 (h)	63.6 (Z)	2133 (h)	5.3 (h)
2 Bottom yellowing. (D)	11.09 (h)	25.6 (h)	0.70	5.6 (h)	3.5	0.64	15.6 (Z)	130.1	4104 (h)	5.5 (h)
3 Yellowing and bronzing. (D)	7.45 (l)	12.77 (h)	0.49 (Z)	2.4	2.5 (l)	0.54 (l)	25.3 (l)	116.6	2623 (h)	2.5 (l)
4 Bronzing	7.7 (l)	8.4 (h)	0.35 (Z)	2.0	3.1	0.78	25.96 (l)	94.8	1673	1.6 (Z)
5 Healthy. (D)	9.19	7.6	0.69	2.7	3.5	0.84	31.3	158.5	1914	4.5
6 " (H)	9.4	6.1	0.55	1.9	3.6	0.72	31.7	118.4	1536	3.3
7 " (H)	8.8	6.1	0.60	3.2	3.3	0.71	36.4	101.6	1350	2.6
8 Average of healthy	9.1	6.6	0.61	2.6	3.5	0.75	34.1	126.2	1600	3.5

Note.—(D) = Diseased. H = Healthy. * Ash = Ash other than silica.

h and h signify respectively definitely a higher and possibly higher values than those of the healthy plants. and l similarly stand for definitely lower and possibly lower values.

(4) *Bronzing*. The bronze colour develops initially from the lower leaves, then affects other parts of the plant, progressively rising from the bottom. Within the leaflet itself the bronze colour is first seen on the margins, then

Bottom Yellowing. Boron in diseased plants seems to be very low, being 15.6 p.p.m. while 31.3 to 36.4 p.p.m. have been found for the healthy. The plants contain excess iron, being 4104 p.p.m. for the diseased as compared to

1350 to 1914 p.p.m. for the healthy ones. There is also more ash, silica potash and probably molybdenum in the diseased plants.

Yellowing and Bronzing. These plants have a smaller content of P_2O_5 , the figures being 0.49 per cent. for the diseased and 0.55 to 0.69 per cent. for the healthy. CaO and MgO as also Mo contents seem to be less in the diseased than in the healthy but the difference is small. Ash content is less in these samples.

Bronzing. These plants show an unmistakably low content of P_2O_5 , the figures being 0.35 per cent. for the diseased and 0.55 to 0.69 per cent. for the healthy. Mo also seems to be deficient in these plants, the figure being 1.6 p.p.m. in the diseased as compared to 2.6 to 4.5 p.p.m. in the healthy ones. Ash content is less and the silica content though more than those of the healthy ones, the difference is not large.

The above observations represent the data obtained in 1947. The results so far obtained from the analysis of similar healthy and diseased samples as above during the year 1948 bear out the above conclusions.

"Bronzing and Yellowing" and "Bronzing" samples show similar low phosphate contents as compared to corresponding healthy ones.

Bronzing 0.46 $P_2O_5\%$ Healthy 0.82 $P_2O_5\%$
Yellowing &

Bronzing 0.38 ,, Healthy 0.53 ,,

Silica content in plants having the above symptoms also show similar higher figures as in the previous years.

"Top Yellowing" has been found to be associated with low manganese content this year (1948) also. The figures are shown below:

Healthy 93 Mg p.p.m.

Top yellowing 68 Mg p.p.m.

From the data presented above it appears probable that these are different diseases.

The authors acknowledge their indebtedness to Dr. J. N. Mukherjee, D.Sc., Director, Indian Agricultural Research Institute, for suggesting the problem, encouragement and valuable suggestions. Mr. K. F. Kheswalla kindly determined the presence of the Fungus organism.

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Research Institute,
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November 9, 1948.

ALKALI-SENSITIVE LINKAGES IN IRRADIATED CELLULOSE

An important development in the chemistry of cellulose in recent years has been the contri-

bution of Davidson¹ on the degradation of certain types of oxidised celluloses by alkaline solutions. The concept of alkali-sensitive linkages vis-a-vis the (modified) cellulose molecule had its genesis in this work and has proved to be of great importance in assessing the value of the prevailing test methods for cellulose.² Precise information on the mode of sensitisation and removal of sensitive linkages is, however, lacking and this would warrant the need for a systematic study of the subject. In the course of a larger investigation on the mechanism of light attack on cellulose, which is in progress in these Laboratories, some evidence has been obtained on alkali-sensitive linkages in relation to irradiated cellulose, and it is the object of the present note to give a short account of this work and discuss the significance of the results.

Cellulosic material as represented by a piece of fresh, highly scoured cotton fabric was initially freed of any alkali-sensitive moiety by boiling repeatedly for eight hours with 1% sodium hydroxide solution. This was ensured by following up the degree of polymerisation (D.P.) during the process of boiling with alkali. The D.P. was estimated through the intrinsic viscosities of the corresponding nitro-celluloses in acetone solution, by employing the Mosimann³ function. In a typical experiment, the following values were obtained for the D.P.

Description of treatment		D.P.
1	Fresh fabric	2295
2	First boiling with alkali	1930
3	Second " "	1805
4	Third " "	1745
5	Fourth " "	1740

A piece of fabric subjected to the action of alkali as above was irradiated uniformly by a Hanovia High Alpine Sun Lamp during 24 hours, the fabric being at a distance of 30 cm. from the lamp. Immediately after irradiation, the fabric was divided into three pieces. All the three pieces ("A", "B" and "C") were stored under identical conditions in a cool dark place. Samples were drawn from each piece initially and at intervals and the D.P. of the basic cellulose material was determined. In the case of fabric "A", such determinations were on the samples as they were on these occasions. Immediately after the irradiation and prior to storage, fabric "B" was boiled with 1% sodium hydroxide solution for eight

hours; the subsequent determinations of D.P. were on samples drawn from the boiled fabric. Samples from fabric "C" were boiled with alkali immediately prior to the determination of D.P. The results of two representative experiments are given in the table below:

TABLE I
Degree of polymerisation during the post-irradiation period

No. of days after irradiation	Experiment I			Experiment II		
	Degree of polymerisation			Degree of polymerisation		
	"A"	"B"	"C"	"A"	"B"	"C"
1	1285	1187	..	1228	898	..
8	1181	1139	1090	1154	923	..
15	1126	1055	1051	..	..	923
22	1070	..	1070	1095	..	898
30	..	..	..	..	921	876
36	1048	1048	..	..	..	..
44	..	..	..	902	..	..
57	..	..	..	898	..	..

The results show that within the limits of experimental error, the ultimate value obtained for fabric "A" corresponds with the initial and all the subsequent values for the fabric "B" and the values of the fabric "C" at any stage. In other words, it would appear that the post-irradiation effect on the irradiated cellulose taking place in atmospheric oxygen and as affecting the D.P. is equivalent to boiling the irradiated cellulose with alkali.

Stillings and Van Nastrand⁴ have reported *inter alia* that the action of ultra-violet light on cellulose is twofold. One of these results in the rupture of glucosidic linkages and the other merely weakens them. The weakened linkages break during post-irradiation period. Although it is by no means certain that the weakened bonds are necessarily glucosidic, the work described in this note, while confirming the general findings of Stillings and Van Nastrand, advances important evidence that the weakened bonds of irradiation are sensitive to alkali and that the slow post-irradiation effects in oxygen leading to the fall in D.P. of the cellulose can be replaced by boiling the irradiated cellulose in alkali.

A fuller account of the above work, as also a description of other aspects of the investigation

on the mechanism of light attack on cellulose, will be shortly published elsewhere.

T. S. A. PADMANABHAN.
Tech. Dev. Estab.
Lab. (Stores),
Kampur,
November 22, 1948,
L. R. SUD.
P. F. E. MAHN.
S. K. RANGANATHAN.
T. S. SUBRAMANIAN.

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Brownsett and Davidson, *Ibid.*, 1941, **32T**, 25. Brownsett and Clibbens, *Ibid.*, 1941, **32T**, 57. 2 Unruh and Kenyon, *Textile Research Journal*, 1946, **16**, 1. 3. Mosimann, *Helv. Chim. acta.*, 1943, **26**, 61 369. 4. Stillings and Van Nastrand, *J. Am. Chem. Soc.*, 1944, **66**, 753.

THE PREPARATION OF TRANSPARENT JELLIES OF ALUMINIUM MOLYBDATE

The author in continuation of his previous work¹ on the preparation of several new jellies, has, for the first time, prepared the jellies of aluminium molybdate. The jellies have been prepared by the metathetical reactions between sodium molybdate and aluminium chloride solutions. 2 c.c. of the aluminium chloride solution (11.5%) are taken in test-tubes and varying amounts of the sodium molybdate solution (20.0%) are added. The total volume is kept 5 c.c. The test-tubes are shaken for about ten seconds and then are kept in a bath maintained at 25 C. The time of setting of the jellies are recorded.

Amount of 20% sodium molybdate (c.c.)	Time of setting (minute.)
2.4	60
2.2	70
2.0	80
1.8	100
1.6	120
1.4	150

These jellies are of the finest texture and are perfectly transparent when freshly prepared. They however have a tendency of gaining slight opalescence when kept for a long time. They are perfectly stable and do not undergo any syneresis. It will be seen from the above that the time of setting of the jellies depends upon the concentration of the sodium molybdate used. The time of setting is also greatly influenced by temperature. They set more readily at high temperatures than at low. They are thixotropic in nature and are very similar to thorium molybdate jellies prepared by Prakash,² by metathetical processes.

The author's thanks are due to Dr. Satya Prakash for his very kind interest in this work.

Chemical Laboratories, S. P. MUSHRAN.
The University, Allahabad,
December 20, 1948.

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Nature, 1946, **153**, 95. 2. Prakash and Dhar, *J. Ind. Chem. Soc.*, 1929, **6**, 587.

CHEMICAL INVESTIGATION OF THE SEEDS OF *JATROPHA CURCAS* LINN.
Jatropha curcas is well known for its seeds which have purgative properties. It is also used in the case of Rheumatism and Itch. The juice of the plant is also reported to contain some colouring matter. As the plant is common in the Tropics, the juice and seeds have already been examined by various investigators.¹ The analysis of two indigenous samples from Malabar and Dharwar have been reported (*loc. cit.*, Alimchandani and Menon). The plant is common throughout the country, but its seed-oil is not utilized for any industrial purpose. In Gujarat, the forest areas abound in these plants, so the seeds were collected from Rajpipla State and the oil and other constituents are being investigated in this laboratory with a view to find the suitability of the oil for industrial use for paint and textile purpose and whether the constituents contain any alkaloid.

The seeds were extracted with carbon tetrachloride for their oil content. The extract after complete removal of the solvent gave bright yellow oil, with not unpleasant smell, which was examined chemically. The yield is 44 per cent.

Jatropha curcas obtained from Rajpipla State (Gujarat). Constants of Oil.

S.P. Gr. at 29° C.	..	0.9440
Refractive Index at 27.5° C.	..	1.475
Saponification value	..	200.8
Acetyl value	..	16.5
Iodine value (Wijs')	..	88.0
Acid value	..	2.6
Acid value in terms of Oleic Acid	..	1.307
Unsaponifiable matter	..	1.1%
B.R. Reading at 40° C.	..	55.0
R.W. value	..	0.9
P value	..	0.1

Constants of Mixed Acids

Iodine value	..	94.7
Saponification equivalent	..	287.7

Constants of Solid Acids

Iodine value	..	2.9
Saponification equivalent	..	276.7

Constants of Liquid Acids

Saponification equivalent	..	291.3
Iodine value	..	111.0

Per cent. of Saturated Acids is 26.5

Per cent. of Unsaturated Acids is 73.5

The further work as regards fractionation of different fatty acids methyl esters, the suitability of the oil for industrial purpose and the isolation of the alkaloids, if any, is in progress. Chemistry Department, C. M. DESAI,
M.T.B. College, M. T. VYAS,
Surat,
December 16, 1948.

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THE DINITRATION OF META-CHLORACETANILIDE

In connection with our studies of the factors involved in the elimination of the nitro-group during the diazotisation of certain nitranilines, it became necessary to prepare a pure sample of 4:6-dinitro-3-chlor aniline in quantity. This compound has been described by Nietzki and Schedler¹ and later by Fries and Roth² who both obtained it by the same method, viz., the action of alcoholic ammonia on 4:6-dichlor-1, 3-dinitro benzene as yellow needles melting at 174° C. (Nietzki and Schedler) or 178° C. (Fries and Roth). Later, Nietzki and Zänker³ claimed to have prepared it from 5-chlor-1, 2, 4-trinitro benzene by the same method. Since the methods mentioned above require the preparation of the intermediates themselves by the chlorination or nitration of suitable benzene derivatives, it was considered to be a more convenient and simple process to start with *m*-chloracetanilide and dinitrate it in one step to the required compound by suitable means.

In an earlier publication⁴ it was mentioned that *m*-chlor acetanilide, when treated with a mixture of potassium nitrate and sulphuric acid was nitrated mainly in the 4-position (Cl=3) whilst the use of nitric acid as such resulted in an isomeric mixture of 4- and 6-mononitro-chloracetanilides which was extremely difficult to separate. Further nitration of either the isomeric mixture, or of the pure mononitro compound with the same but fresh reagent failed to give the desired dinitro compound.

According to Kehrman and Stanoyevitch⁵ when *m*-chlor acetanilide was added in small amounts to a well-stirred mixture of one part of nitric acid (1.52 d.) to three parts of

sulphuric acid (1.8 d.) kept at 0° C., only 4:6-dinitro-3-chlor-acetanilide resulted, but the yield was not specified. This was identified by the free amine (m.p. 174° C.—cf. N & S) liberated on hydrolysis with dilute sulphuric acid. On repeating this dinitration in the manner described, the desired product (m.p. 174° C.; acetyl derivative m.p. 133° C.) was obtained, but in an yield of only 10% mixed with an almost equal amount of the mononitro derivative, viz., 4-nitro-3-chlor aniline (m.p. 157° C.—acetyl derivative m.p. 144° C.). A neat method of separation of these two nitro compounds has been worked out by us on the basis of the general principle that a dinitro benzenoid base was comparatively less basic than its mononitro counterpart and was therefore less liable to form soluble salts in acid media. In fact, when the crystallised product of dinitration consisting of a mixture of the acetyl derivatives of the mono- and dinitro chloranilines was hydrolysed using 50% dilute sulphuric acid, the mono-nitro base remained in the cold solution while the free dinitro base remained insoluble and could be filtered off and was found invariably to be pure—the mono-nitro amine could also be obtained pure from the filtrate by dilution with water and filtration.

The formation of both mono- and dinitro derivatives during the nitration in the manner described seems to have escaped the attention of Kehrman and Stanoyevitch. However, the presence of monoderivative clearly shows that the dinitration is a two-stage operation and that, in the first place, the 4-position is occupied by the entering nitro group and it was only after that that the 6-position was attacked. The latter position is obviously more resistant towards nitration, as is indicated not only by the poor yield of the 4:6-dinitro body but also by the total absence of the 6-nitro mono derivative in the nitration products. It was thought probable that the non-completion of the nitration of the mono-nitro derivative to the dinitro stage was also partly due to the dilution of the acid mixture employed and its consequent ineffectiveness in attacking a position already resistant and made more so by the groups already existing in the molecule. A remedy for this appeared to lie in the employment of a mixture of nitric acid (1.52 d.) and fuming sulphuric acid (12% oleum); the dinitro compound was then observed to be the sole product of nitration, to the complete exclusion of the mono-nitro derivative. The yield of the required dinitro base was also found to have

increased almost to double. Further, on repeating the same procedure, starting with the 4-nitro-3-chloro acetanilide, obtained by the nitrate-sulphuric acid mixture (yield 54%—*loc. cit.*), the same yield of dinitro base resulted thus furnishing further evidence for the two-stage character of the dinitration and also the possible explanation for the non-completion of the dinitration when the Kehrman and Stanoyevitch acid mixture was employed. Further details will be published elsewhere.

Our thanks are due to the C.S.I.R., India, for a grant which defrayed the expense of this investigation and for permission to publish the preliminary results. We also record our thanks to Prof. R. D. Desai of the Department of Chemical Technology, University of Bombay, for a further gift of 100 gm. of *m*-chloraniline-HCl.

Chemical Laboratories, B. B. DEY.
Presidency College, R. KRISHNA MALLER.
Madras, B. R. PAI.
January 1, 1949.

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PRELIMINARY ANTIMALARIAL SCREENING TESTS OF SOME BIGUANIDE DERIVATIVES

A number of communications¹⁻⁵ have been published by us, on the synthesis of new potential antimalarials of the substituted biguanide type. The results of testing of some of these compounds against avian and simian malaras are now reported.

Avian Malaria Tests.—Although the synthetic compounds could be tested in a number of ways in the light of recent developments in the field of antimalarial testing^{6,7} but for the present work as a preliminary screening test, only the suppressive antimalarial activity of the compounds against the blood induced infection of *Plasmodium gallinaceum* in chicks, has been evaluated. Young cross breed country fowls, 8-10 weeks old, were infected intramuscularly with citrated blood freshly drawn from control birds showing peak infection. The size of the inoculum was so adjusted that the control group showed peak infection after 8-10 days invariably. Treatment group was orally fed with the requisite

dose of the drug (in aqueous solution or suspension) twice daily for four days after 48 hours of infecting. After the treatment was over the blood smears were examined daily and the delay in reaching the peak infection in the case of drug treated group of birds in comparison to that of control was taken as criteria for the suppressive antimalarial activity. The antimalarial activities given below are with respect to paludrine which has given the maximum time lag between the peak infection of control and treated groups.

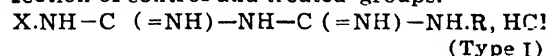
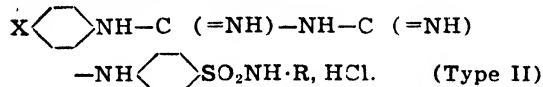


TABLE A. Analogues and isomers of paludrine.

No.	X	R	Dosage mmg./100 gm body weight	Activity
1	<i>p</i> -Chlorophenyl	Isopropyl (Paludrine)	6	+++
2	do	do (acetate salt)	6	+++
3	<i>p</i> -Fluorophenyl ⁴	do	20	+(toxic)
4	<i>m</i> -Chlorophenyl ⁴	do	4	-(toxic)
5	2:4-Dichlorophenyl ⁴	do	20	++
6	do	do	40	-(toxic)
			20	-(toxic)
		Methyl-propyl	4	-(toxic)

Metachloro analogue of paludrine (No. 4) has shown good activity while the fluoro analogue has been found to be inactive and toxic. The presence of an additional chlorine atom in the *p*-chlorophenyl ring of paludrine has also not led to active compounds (No. 5,6). In the case of toxic compounds, most of the treated birds died during or just after the treatment and on dissection showed Hæmorrhage in the gizzard and congestion in the gullet indicating local irritation.



It may be concluded that some of the sulphabiguanide derivatives obtained from *N*-pyrimidyl-sulphanilamides showed good suppressive antimalarial activity when tested at relatively large dosage. This suppressive activity is however not comparable to that of quinine or paludrine. Toxicity of compound No. 17 was determined in mice. Sulphabiguanides did not form metallic complexes

TABLE B. Sulphabiguanides.

No.	X	R	Dosage mmg./100 gm. b. wt.	Activity
7	Cl ¹	H	6	-
8	CH ₃ O	H	12	-
			6	-
9	Cl	2-thiazolyl ¹	12	-
10	Br	do	20	-
11	H	2-pyrimidal	40	-
12	Cl	do	40	++
13	Br	do	40	+
14	CH ₃ O	do	20	-
15	NO ₂	do	20	++
16	Cl	6-methyl-2-pyrimidyl ²	20	-
			40	++
17	Cl	6:4-dimethyl-2-pyrimidyl ²	40	+(toxic)

(chelates) and activity in the case of these compounds shows that for antimalarial activity a suitably substituted biguanide group may be sufficient, apart from other considerations.

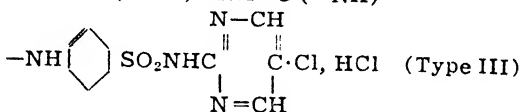
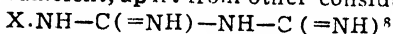
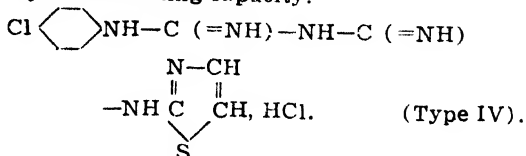


TABLE C. Meta-chloridine substituted aryl biguanides.

No.	X	Dosage mmg/100 gm. b. wt.	Activity
18	<i>p</i> -Chlorophenyl.	40	++ (toxic)
19	2:3-Dimethyl phenyl.	20	+

Although the above group of compounds showed suppressive antimalarial activity, compound No. 18 was found to be toxic at the above dosage. Compound No. 19 was however found to be non-toxic at this dosage when tested in mice, but was relatively less active. Metachloridine substituted arylbiguanides resemble sulphabiguanides as regards their activity and chelating capacity.



Compound (IV) (No. 20) when tested at a dosage of 40 mmg./100 gm. b. wt. was only found to be slightly active and excessively toxic. Replacement of isopropyl group by thiazolyl

ring in the paludrine molecule does not seem to result in active compounds.

Simian Malarial Tests.—Some of the compounds reported above were also tested against blood induced infection of *Plasmodium knowlesi* in Rhesus monkeys at the Malaria Institute of India for assessing their preliminary suppressive activity.

m-Chloro analogue (No. 4) and *p*-bromo analogue (Type I; X = *p*-bromophenyl) of paludrine have shown encouraging suppressive activity. In the sulphabiguanide series, compound No. 7, 9, 11 and 17 have been found to be inactive while compound No. 16 as well as bromoanalogue of compound No. 7 (type II; X = Br) have shown encouraging suppressive activity. Compound No. 18 and 20 have also failed to show any noteworthy activity.

These results are generally in agreement to those obtained in the case of avian malaria screening tests.

Our thanks are due to Dr. K. P. Menon for his keen interest and valuable help. Authors also wish to thank Director, Malaria Institute of India for the simian malaria tests and to the Indian Research Fund Association for the award of a fellowship to one of them (H. L. Bami).

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S. NATARAJAN.

Pharmacological Labs., A. S. RAMASWAMY.
Indian Inst. of Science, N. N. DE.
Bangalore 3,
February 10, 1949. B. H. IYER.
P. C. GUHA.

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INFLUENCE OF HYDROXYCARBOXYLIC ACIDS ON THE REACTION BETWEEN α -NAPHTHYLAMINE AND DICHROMATE AND α -NAPHTHYLAMINE AND VANADATE

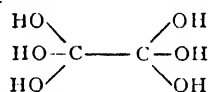
THE catalytic influence of the oxalate ion on the reaction between hydriodic acid and dichromate,¹ hydrobromic acid and dichromate,² aromatic amines and dichromate,³ hydriodic acid and vanadate,⁴ and aromatic

amines and vanadate⁵ has been previously reported.

van Eck⁶ has developed a colorimetric test for dichromate. According to him, addition of a trace of α -naphthylamine to a solution of potassium chromate and subsequent acidification with tartaric acid produces an intense blue coloration. He claims that the reaction can be used for the colorimetric estimation of dichromate.

Experiments now carried out have shown that the action of tartaric acid is mainly catalytic and not due to its hydrogen-ion concentration, since no color was produced when sulphuric, hydrochloric and acetic acids were employed for acidifying the solution. Moreover, other hydroxycarboxylic acids like citric, lactic and malic acids were found to catalyse the color reaction. Oxalic acid, though a carboxylic acid, is found to be more active than even the hydroxyacids. Vanadate also produces a blue color with α -naphthylamine under similar conditions.

This peculiar property of oxalic acid can be satisfactorily explained by the theory of Bergel,⁷ who suggested that oxalic acid in its hydrated form can be represented as a poly-hydroxy compound with the structure



Details will appear elsewhere.

Chem. Lab., M. NARASIMHA SASTRI.
Andhra University, J. V. S. RAMANJANEYULU.
Waltair,
January 27, 1949.

1. Viswanadham, C. R., and Gopala Rao, G., *Curr. Sci.*, 1942, **11**, 102. 2. —, *Ibid.*, 1943, **12**, 186. 3. —, *Ibid.*, 1944, **13**, 47. 4. —, *Ibid.*, 1943, **12**, 229. 5. Narasimha Sastri, M., *ibid.*, 1943, **17**, 327. 6. van Eck, P. E., *Chem. Weekblad*, 1915, **12**, 63. 7. Bergel, F., *University of Leeds Magazine*, 1944.

A PRELIMINARY INVESTIGATION INTO THE VIABILITY OF IMMATURE EMBRYOS OF CORN UNDER CONDITIONS OF COLD STORAGE AT FREEZING POINT

IN any investigation involving embryo culture requiring the dissecting out of several hundreds of embryos from immature kernels of corn (maize) or other plants, any method that helps to preserve the young embryos from loss of viability should have a special significance in that such an operation could then be conducted through several days or longer, without being obliged to do it all at one moment. The present

investigation was conducted to see if cold storage at freezing point would help to preserve the viability of the immature embryos of corn and if so, for how long. A 3-week-old corn cob from an inbred stock, with husk intact, was placed in the refrigerator immediately after harvest on August 31, 1947. The embryos were dissected out of their kernels and daily tested for viability in Tukey's culture medium from the time the kernels were kept in the culture medium and continuing until the embryos showed no sign of viability. The kernels were plump at the time of keeping in the refrigerator. After five hours they had already shrunk at the bottom. A sort of dryage was evidently in progress. After a week they were distinctly shrunken. At the end of twelve days they had practically flattened out and the borderline of the embryo was clearly thrown out to view at the anterior surface of the kernel. At the end of sixteen days the seed coat had become as hard as that of a matured seed. Thereafter the dissecting out of the

embryo became difficult. Ten embryos were tested each time. They showed hundred percent viability till the sixteenth of October 1947. Thereafter there was a steady decline in the viability. None of the embryos kept on the 26th of October germinated, while only one out of ten excised on the 25th of October germinated. Hence the period of viability for a 3-week old embryo kept in cold storage at freezing point, appears to be approximately a month and a half. The period, however, may not be the same for older or younger embryos.

In the present investigation, however, the embryos were obtained from a single ear. To confirm the result, embryos should be tested from more than one ear and the test repeated.

Agri. Res. Institute,
Coimbatore,
January 19, 1949.

P. UTTAMAN.

1. Tukey, H. B., *Proc. Am. Soc. Hort. Sci.*, 1934, **32**, 313.

RESEARCH INFORMATION SERVICE

RESearch INFORMATION SERVICE, established translators of foreign scientific and technical material, have introduced a new and much-needed service by cataloguing and preparing translations of articles from *current Russian technical and scientific publications*.

Although Soviet presses pour out hundreds of magazines and reports covering an enormous range of subjects, the greatest portion of which are being imported into this country, only a very small percentage of this material has been of practical value heretofore because of the lack of qualified translators and the exorbitant cost of technical translations.

Pioneers in this field, Research Information Service has undertaken to catalog the material received in this country—comprising tons of printed matter on Russian scientific and industrial activity—and then to screen and translate and publish at reduced cost—at a fraction of the cost of “made-to-order” translations—that information which is of most immediate interest to American industry.

For this purpose Research Information Service maintains a staff of qualified linguists, editors and translators, trained expressly for scientific and technical work.

Translations immediately available—listed in Research Information Service Bulletin No. 27—deal with problems in the petroleum industry. The Bulletin lists translations on such subjects as *Problems of High-Speed Drilling, Problems and Methods of Medium-Speed Oil Products, Pressure Heads in Oil Bearing Formations and Rates of Flow, the Solubility of Natural Gas in Petroleum, the Boiling Temperatures of Olefins, Studies on the Inflammability of Gases, Convection and Inflammability in Ether-Air Mixtures*, etc.

At present the company is preparing Bulletins listing translations of articles in fields such as metallurgy, agricultural chemicals, medicine, aeronautics, machinery and several others. These Bulletins will be made available to industry in the very near future.

Special arrangements for translations of foreign language material now in the hands of individual companies can be made through the *Industrial Translation Division* of Research Information Service, whose sales-translation plan has already gained widespread acclaim.

Translations and Bulletins listing translations may be obtained from the publishers, Research Information Service, 509 Fifth Avenue, New York 17, N.Y.

REVIEWS

Spectroscopy and Combustion Theory. By A. G. Gaydon. (Chapman & Hall, Ltd.), 1948. Pp. 242. Price 25sh. Net.

As is well known, the history of the progress of chemistry is knit closely with the study of combustion. In flames where reactions are running fast, the spectroscopist has played an important role in revealing some of the constituents of flames. In many cases it has provided quantitative information about the mechanism of flame reactions and has also helped in the measurement of the temperature of flames. In recent years spectroscopy has made an important contribution to combustion theory. In the present monograph, Dr. Gaydon has collected together what the spectroscopist tells about flames. It is a revised edition of the book first published in 1942, and embodies the many recent developments in this active field of research. Large sections have been added and others have been entirely rewritten.

After a general introduction to the subject, the author gives an elementary treatment of the theory of molecular spectra in Chapter I for the benefit of those who have not had a specialised training in spectroscopy. The presentation has been made as simple as possible with special emphasis on the practical applications of the subject. In the second chapter which is on emission spectra, the conditions under which they appear and their interpretation are fully discussed. Stress is laid on the quantity and the quality of light emitted. This Chapter therefore provides the theoretical background for understanding many of the quantitative investigations discussed in later chapters. The experimental aspects of the study of emission spectra are also briefly dealt with in the same chapter.

The next six chapters deal with the results of the study of the emission spectra of various flames and explosions such as the hydrogen flame, the hydrocarbon flames, cool flames and atomic flames, etc. The probable emitter and the significance of the hydrocarbon flame bands are discussed fully. The origin and nature of the flame spectrum of carbon monoxide is treated at some length in Chapter IV. These chapters also include a brief report of the investigations of the spectra of cool flames, explosion flames and of the internal combustion engine. Chapter IX is devoted to

the subject of continuous spectra. It also deals with the nitric oxide test for atomic oxygen in flames.

The study of absorption spectra is potentially a very powerful method of investigating the progress of slow combustion processes and chemical reactions in the gas phase. This subject is considered in some detail in Chapter X. A critical discussion of the advantages and limitations of absorption spectra for studying combustion problems included in that chapter is extremely useful. It is well known that quite an appreciable part of the energy radiated by flames falls in the infra-red region. Chapter XI describes the numerous investigations carried out on the spectra of flames in the infra-red region. There seems to be an intimate relationship between the infra-red radiation and the after-burning and the so-called latent energy of the combustion. This is fully borne out by the results of numerous researches carried out by Dr. Gaydon which are briefly discussed in Chapter XIII.

In Chapter XII entitled "The lifetimes of activated molecules" are described the methods by which the radiative and collision lives of activated molecules may be determined. The available data on actual molecules are also mentioned and discussed. Chapters XIV and XV deal with two important topics, namely, flame temperature methods for their measurement, and dissociation energies respectively. In addition to the results obtained from the studies of the emission and absorption spectra of flames, spectroscopy has contributed to the quantitative side of combustion theory in many ways. Some of these are discussed in these two chapters which deal with the calculations from spectroscopic data of specific heats, energies of dissociation, etc. In the concluding chapter entitled "Kinetics of Spectroscopy" the author summarises the present contributions of spectroscopy to combustion theory and gives some pertinent suggestions regarding the lines along which the application of spectroscopy to the theory of combustion may be developed most profitably. He has pointed out the need for quantitative rather than qualitative observations and the importance of the use of spectroscopic data in following the kinetics of the combustion process.

In the Appendix are given some details which would be useful for the recognition of spectra frequently encountered in combustion work. A list of the chief characteristics of flames, data on atomic and molecular energy levels and physical constants are also included in the Appendix. A fairly complete bibliography containing more than 300 references to original publications on the subject is also appended.

The present monograph has been written by one who has himself made many notable contributions to the technique of flame spectroscopy and molecular spectrum analysis and can therefore be considered as an authoritative report on the subject. It is the only work solely devoted to the subject. As the author has attempted to cover the whole field of the applications of spectroscopy to combustion theory fairly fully, many topics have been presented in a condensed form. The treatment is also not mathematical. It can be easily understood by anyone who is familiar with the elements of spectroscopy. As Sir Alfred Egerton says in his Foreword, "Many will find useful a book which collects together what the spectroscope tells about flames".

R. S. K.

History of Dyes and Dyeing in the Bombay Presidency. By B. N. Phadke. (Published by Messrs. Dastane Bros. Home Service, Ltd., Poona City). Pp. xx+152. Price Rs. 12.

Once in a way, it will act as a good mental tonic to read through books of ancient glory in arts and crafts. The present historical account of dyes and the art of dyeing is no exception to this rule. One will be surprised to find how people, in those days of comparative ignorance and superstition, developed the art of dyeing to such scientific perfection. Fermentation technique was employed for the preparation of indigo white without knowing that yeast was responsible for fermentation. Bark extracts were employed to mordant textiles without knowing that tannin was the mordanting agent. These were the achievements of great concentration and experimentation.

The volume under review, gives a lucid historical survey of the dyes used in the Bombay Presidency and the methods employed for their application to textiles right from the old village dyer to his counterpart in the process textile mills. The first chapter gives the historical background of the dyeing from the

Vedic times to the present period. The great skill of the ancients in the presentation of hue, shade and tint has been described in detail. The second chapter deals with the development of indigenous dyes in the Bombay Presidency and indicates the adverse effect of the introduction of the synthetic dyes on the indigenous ones. The application of indigenous dyes to cotton, silk, wool, ivory, wood and leather is discussed in detail. The third chapter gives a good account of the application of mineral pigments on textile fibres. The fourth chapter is the most important one since it gives the details of application of synthetic dyes to various textiles. Application of synthetic dyes to miscellaneous purposes such as yarn printing, writing inks, food colours, wood and paper colours, etc., has also been fully indicated. The fifth chapter is devoted to a comparison of synthetic dyes with the indigenous ones and the author comes to the inevitable conclusion that indigenous dyes can never compete with the synthetic ones. The Appendix deals with the history of the development of Dyestuff Business, details of production and composition of vegetable and animals dyestuff of the presidency and various other useful tabular data. The author has to be specially congratulated on winning the 'Ashburner' prize for the compilation of this volume.

M. R. A.

Principles of Biological Assay. By C. W. Emmens. (Chapman & Hall, Ltd., London), 1948. Pp. xv + 206. Price 21sh.

In this book the author discusses statistical methods of interpreting experimental results and gives formulae to be used in determining the accuracy and adequacy of experimental findings. He has given many examples of experimental results together with calculations necessary for the purpose of assigning limits within which the potency of preparations may be presumed to fall in comparison with a standard. The variation between animals is very great and in order to allow for the differences it is essential to plan experiments carefully and to determine how far differences between groups are due to the factors which are being studied. Throughout, the author lays stress on the proper use of modern statistical methods.

The introductory chapter discusses the application of mathematics to biological measurements. Later on certain principles of

design are illustrated and subsequent chapters deal with the randomised block and the latin and higher square designs. New and complex extension of these to the factorial design and to the value of concomitant measurement in design are also treated. Particular attention has been drawn to the necessity of a valid estimate of experimental error.

The book satisfies the requirements of sound and intelligible experimental design and supply the machinery for unambiguous interpretation. The examples chosen in the book are aimed at illustrating the principles of successful experimentation. It is a very useful book for exact tests of significance and fully illustrates the variety of computational procedures. The book will be of great interest and value to the research workers and students of pharmacology and experimental therapeutics and to analysts.

N. N. DE.

The Grasslands of Latin America. By G. W. M. Roseveare. (Published by the Commonwealth Bureau of Pastures & Field Crops, Aberystwyth, Great Britain), August 1948. Price 20/-.

This is a very comprehensive publication which brings together a vast quantity of information regarding the grasslands of Latin America, both the natural grazing areas and the pastures and leys. The countries covered comprise more than a continent, extending from Mexico in the north to Patagonia in the extreme south, the whole indeed of Central and South America. The diversity of environment in this vast area can easily be imagined. Differences in soil, altitude, temperature, rainfall and snowfall, proximity to the coast or otherwise, mountain pastures, treeless plains, flooded riverbanks, eroded surfaces and so on, with their distinctive grass flora and their peculiarities as fodder—all of these give rise to a formidable variety in the material dealt with. As the Preface states, hundreds of books, journals and occasional publications, many of them written in foreign languages, have been laid under contribution and a vast array of information brought together. Practically every conceivable aspect of the subject is gone into and the book is a veritable mine of interesting and valuable information. Surveys according to the climatic zones and under three classes such as tender, strong and hard grasses, their distinctive characters, floristic composition, the role of lucerne and other leguminous vegetation, productivity of

the grasslands, soil surveys and a correlation of the nutritive value of the herbage with the type or composition of the soil, the relation of legumes in kind and bulk to the soil, soil degradation and grass cover and many similar subjects relating to the grasslands of each State come under this section. Many of the surveys are interesting in that a large number of Indian grasses figure among them, even the dominant grasses being the same. Under temporary leys are dealt with very interesting subjects like cultural technique, seed production, breeding of new varieties, growth habits, out-turns, chemical composition, feeding value and palatability, feeding trials and other matters, relating to each one separately, of lucerne leys, other leguminous leys, cereal and other mixed grass leys. Some noteworthy material in this section, among other things, is the work on the toxicity of some sorghums (a familiar trouble in India) and the seed production of lucerne, in which it is stated that seed from dry land lucerne is preferred to that from irrigated lucerne though the latter seeds in abundance. A list of shrubs and trees of fodder value (called, 'brouse' plants) with botanical names and descriptions, including those which are believed injurious or even poisonous comprises another chapter. We note that studies are in progress and that some success has been attained in breeding sorghum varieties with a very low hydrocyanic acid content.

A most interesting chapter is the one on soil erosion, and conservation, not only on grasslands but also in the extensive coffee plantations.

Many veterinary problems connected with grasslands are dealt with in another chapter; these include deficiency diseases (like osteomalacia), remedial measures, the tick scourge and its control (which is particularly valuable as a matter affecting most Indian pastures) locust invasions, fungus parasites, weed infestation (among which figures our familiar friend, *Cyperus rotundus*) and other matters. In the chapter on grassland management which follows is given a useful resumé of the case for and against the annual burning of grasslands, a practice also familiar in India. The last chapter describes the scientific research and experimental work in progress in all the different States, the scope of which should be an eye-opener to many of us. We have nothing but unstinted praise for this excellent book, which ought to find a place in every agricultural library.

A. K. Y.

FUGITIVE MOLECULES

THE last quarter of a century has witnessed considerable change in our concept of the nature of a chemical bond and an important contribution in this development has been the discovery of a number of labile molecules some of which had extremely short life. Studies in reaction kinetics have been not a little responsible for bringing such molecules to our notice. The Faraday Society Discussion on Free Radicals in 1933 covered only the preliminary exploratory work while the discussion on Oxidation in 1945 dealt with one aspect of the problem. A fuller discussion is thus a necessary sequel and the report of the Discussion on "Labile Molecules" in 1947* which has recently been published is a welcome contribution.

The report includes papers under four broad subdivisions: Theoretical, Gas Phase, Liquid Phase, and Polymerisations. The theoretical part is naturally the shortest section. It is now well recognised that in the distinctions between the different carbon compounds, the bonds formed by carbon involve a certain amount of hybridisation, with a continuous interplay of *s* and *p* in varying proportions, the total of *s* and *p*, however, being maintained constant. The special configuration around a central atom is primarily governed by the extent of hybridisation. The nine papers in this section cover the ground using both the molecular orbital and the valence bond methods. The opening contribution by Coulson gives a concise review of the present position of the theory bringing out clearly the inherent difficulties. The fundamental character of a free radical is the presence of an unpaired electron and the distinction between the different free radicals lies precisely in the position and degree of localisation of this electron. Difficulties are inherent in any quantitative evaluation of this aspect which is essential in any interpretation of reactivity but the results obtained are none the less useful. Walsh's contribution is a logical development of the fundamental principle enunciated at the beginning of his note 'The more *s* character in a carbon valency, the more electronegative is the carbon atom in that valency'. Daudel and co-workers have made effective use of the valence bond method in the shape of a molecular diagram with the bond lengths defined by a mobile bond order termed by them "*indice de liaison*" while homolytic activity is defined by free valence "*indice de valence libre*". An extended

table for a number of aromatic free radicals with the diagrams is a useful contribution for use in calculations of reactivity. The picture of π -complexes given by Dr. Dewar is no doubt an attractive one but much more than the evidence given is needed before it can be accepted in full. Any picture of chemical reactivity without reference to the energy of the transition state must necessarily be inadequate. It would be also interesting to see if the rather unorthodox formulation of cyclopropane and of ethylene oxide help in accounting for some of the abnormalities of the Raman spectrum of these compounds.

The final picture one gets is that in spite of some advance in quantitative interpolations, theoretical development has not been able to indicate any fresh qualitative principles for further experimentation.

A group of thirteen papers cover the ground of gas-phase reactions, the bulk of which deal with the labile molecules in hydrocarbon reactions. Both spectroscopic and kinetic investigations have revealed that there are relatively few simple polyatomic labile molecules. Band spectra are known for CHO, NH_2 and CH_2 and Gaydon has added BrO and CBr. As Hinshelwood remarks in his introduction, a good deal of chemistry will have to be rewritten if the existence of the labile molecule HO_2 is not postulated but one has to accept the position that the objections raised over ten years ago on the use of a semi-empirical method for quantitative evaluations still hold good and the quantitative evidence in support of this postulated molecule makes use of only this mode of approach.

The chemical reactions of hydrocarbons can be considered under the heads: Decomposition into free radicals, reaction of free radicals or of atomic hydrogen or other similar element with hydrocarbons and other free radicals and oxidations. Steacie has brought out the need for further work on atomic hydrogen-hydrocarbon reactions while Watson has brought out the differences in C-H bond energy with progressive substitution at the carbon atom by alkyl groups. Oxidation reactions naturally figure prominently in the discussion as this involves unstable intermediates and emphasises the trend of kinetic studies in ignoring the stoichiometric equation and considering only stages in the mechanism each of which involves only a few atomic

* *Discussions of the Faraday Society*, 1947, Number 2.

movements of the simplest character. The observations of Partington on the pyrolysis of hydrocarbons do not conform, as may be expected, to the theory that the energy of vibrational degrees of freedom can contribute to the activation energy. The pyrolysis rate constant appears to be practically constant when the number of carbon atoms in the chain exceeds 6. In contrast to this, oxidation appears to rapidly increase with the length of the hydrocarbon chain. The course of oxidation seems to be on the lines expected for a Semenov 'degenerate branching chain' mechanism. It is obvious that further work is necessary for a full understanding of the problem of oxidation of hydrocarbons in the gas phase.

Minkoff has critically examined the problem of the radical HO_2 in the gas phase and has applied Eyring's method to the reaction system which appears to indicate a trough in the reaction co-ordinate corresponding to the formation of this radical as an intermediate. Contrary to other observations, Chara claims to have isolated a compound of the formula H_2O_4 by cooling the products of an electrodeless discharge but this requires confirmation. Spectroscopic evidence is lacking and one awaits with interest the results of an infrared study referred to in the paper. Gaydon has been able to obtain radical spectra by a simple device for the study of flame spectra of low pressure flames and is besides able to indicate possible mechanisms for the formation of these radicals. One result of these investigations is the report of additional labile molecules.

Reactions in solution naturally occupy an important section of the discussion and the last ten years have shown the wide occurrence of free radicals in a variety of homolytic and heterolytic reactions. Waters finds that persulphate oxidations and oxidations with Fenton's reagent can be adequately represented by a simple chain mechanism involving hydroxyl radicals. One needs much more than the evidence of chemical reactions before accepting the statement "The exact formulation of the alcohol radical is a moot point particularly since the possibility of tautomerism must be conceded" (italics mine). I should also consider that it is not safe to conclude only from the relative velocity constants that aldehydes react in the hydroxylic form. Weiss' report of "Active" oxalic acid is a significant contribution on the oxidations using permanganates and one can safely add C_2O_4^- to the list of known free radicals.

The contribution on the decomposition of silver alkyls only serves to indicate that much more has to be done in the study of these organometallic compounds before any generalisations are possible.

It is difficult to agree to Dr. Mann's definition of a free radical as "a neutral group of combined atoms one of which possesses a deficiency of electrons so that the group can combine in pairs". This definition implies that any monomer which readily forms a dimeric molecule should be termed a free radical and the term can be held applicable in such a case to compounds like aluminium chloride or bromide, aluminium trimethyl and formic acid! The experimental fact that is referred to certainly needs explanation but not by such devious definitions.

While transient intermediates have been postulated in several reactions, their short life makes it very difficult to prove their presence by other methods. The contribution by Denbigh and co-workers is quite a welcome one in indicating a method of using of flow technique to maintain a steady state so that transient intermediates can be examined, even though the concentration is small.

The last group of fourteen papers cover different aspects of the phenomenon of polymerisation in which free radicals play quite a significant part. N-nitroso acyl aryl amines are found to be efficient catalysts in initiating polymerisation, the products formed by their decomposition into free radicals being invariably found in the final polymer. Dr. Magat's report during the discussion of a nonphoto-chemical temperature independent method of producing free radicals by using the Szilard effect is an indication of a fruitful new line of approach to the problem. Dr. Mayo's contribution on copolymerisation clearly brings out that a terminal ethylenic bond with conjugated unsaturation is an important factor in reactivity but at the same time, the reported results indicate how other factors have also to be taken into account. The influence of a substituent on styrene polymerisation is found to be analogous to that of polar substitution reactions but in carbonyl conjugated compounds the influence appears to follow a different order, a feature not surprising in the complex field of free radical kinetics. Price's interesting analysis of the problem enables him to separate copolymerisation ratios, where there is no complication of a disturbing steric factor, into a 'polar' factor and a 'general monomer reactivity' factor. While the role of solvent in reaction

kinetics is still not fully understood, in the field of polymers it has been clearly established that they take part in chain transfers and the influence of a solvent is quite marked. Bamford and Dewar's papers provide further evidence of this phenomenon. An analysis of the group of papers shows that the activation energy of these reactions involves not only the resonance energies of the radical initiating the reaction and of the monomer and the nature of the repulsion energy but also the resonance energy of the transition state. The solvent influence in chain transfers is fully substantiated by the contributions of

Melville, Mayo and others in the next group. Solomon has attempted to use Dewar's π -complex picture in the study of radical reactions and finds the 'steric effect' of bulky groups an obstacle for generalisations. He is able, however, to successfully use the idea in a study of rubber-like products.

The present discussion maintains the tradition that one has come to associate with 'Discussions of the Faraday Society' and is suggestive of further fundamental work in a fruitful field.

S. V. ANANTAKRISHNAN.

SCIENCE NOTES AND NEWS

Association of Scientific Workers of India

The second Annual General Meeting of the Association of Scientific Workers of India was held on January 4, 1949, with Dr. T. N. Seth, Professor of Medical Chemistry, Medical College, Patna, in the chair. The following National Executive of the Association has been elected for the year 1949. *President:* Pandit Jawaharlal Nehru; *Vice-President:* Dr. B. C. Guha; *General Secretaries:* Dr. P. K. Kichlu; and Mr. C. R. Mitra; *Joint Secretary:* Mr. S. Bhattacharji; *Treasurer:* Dr. D. V. Karmarker; *Members:* Dr. A. N. Bose, Dr. S. Banerji (Calcutta), Mr. Bharat Bhushan, Mr. S. K. Mohindra (Delhi), Dr. T. D. Patel, Maj.-Gen. S. S. Sokhey (Bombay), Mr. N. R. Srinivasan (Bangalore), Mr. A. C. Sen (Patna), Mr. S. C. Roy (Lucknow), Mr. H. Hasan (Aligarh), Dr. B. Prasad (Cuttack), and the Secretaries of the Branches at Delhi, Calcutta, Bombay, Bangalore, Lucknow, Raniganj, Naihati and Patna.

Admission to Educational Institutions Abroad

The Government of India have had under consideration for some time past the problem of ensuring that Indian students proceeding abroad at their own expense benefit to the fullest possible extent from the educational opportunities provided by institutions abroad.

For the purpose of imparting information and guidance to students wishing to proceed abroad, the Government of India have set up an Overseas Information Bureau in the Ministry of Education. Besides this Bureau, there are at present a number of University or Provincial Students' Advisory Bureaux in the Provinces and the States.

Students wishing to proceed abroad at their own expense are required to contact

for information, etc., the nearest advisory organisation in their Province or State and also submit their applications for admission to that Bureau for onward transmission to the Ministry of Education, Government of India. Students of the areas in which there are no such advisory organisations may, however, apply direct to the Ministry of Education.

It is desirable that only students with good academic qualifications should seek admission in foreign universities.

Atomic Energy Commission—India

The first conference of the Atomic Energy Commission met today at New Delhi to draw up a syllabus for the teaching of nuclear physics, chemistry and mathematics to the University students to equip them for research work in atomic energy.

The conference was attended by Dr. H. J. Bhabha, Dr. S. S. Bhatnagar, Dr. S. N. Bose and Dr. R. S. Krishnan, members of the Atomic Energy Commission and 23 other scientists who represented 14 Indian universities and scientific institutes.

Meteorological Mission to Himalayas

With a view to studying meteorological conditions associated with atmospheric disturbances in the Ladakh Valley and the adjoining Himalayan regions, in order to make flying safe in these regions in the cold weather, an RIAF meteorological expedition led by Flying Officer K. Chandra, recently left for Ladakh.

The party will study conditions in these regions and particularly those at altitudes ranging from 18,000 to 20,000 feet above sea level. Its medical research team, under the supervision of Major S. L. Kalra, will study medical problems connected with high-altitude

flying, the depth of air pressure at different heights and how it affects the human body.

This is the first expedition of its kind to undertake a meteorological survey of the Himalayan regions in winter. If successful it will have a far-reaching effect, as an all-weather route through these regions will bring these remote Himalayan regions in closer contact with India, thus opening a new chapter in cultural intercourse between the land where Buddhism flourished and the land that gave birth to it.

The expedition has been made possible by the untiring efforts of Air Commodore A.M. Engineer and Wing Commander H. Moolgaonkar.

Agricultural Meteorology and Hydrology

The Asian Conference of Weather Experts decided at one of its sittings to appoint two Sub-Commissions for Agricultural Meteorology and Hydrology to work in close collaboration with the permanent Commissions of the International Meteorological Organisations and to advise the Member States in this region.

The Sub-Commission on Agricultural Meteorology will have representatives of the USSR, Japan (Scap), India, Pakistan, Indo-China, Siam and Indonesia as members. India's representative, Dr. L. A. Ramdas, will be the Chairman.

The Sub-Commission on Hydrology will have as its members representatives of India, Pakistan, the USSR, China, Siam, Indo-China and the Philippines.

Both the Sub-Commissions will have the power to co-opt additional members, if necessary.

The Conference also discussed the question of standardisation of meteorological instruments. It was felt that Asia should be subdivided into four regions for purposes of inter-comparison of standard barometers, etc.

Co-ordination of Plant Protection Work in India

A meeting was convened on 12th January 1949, under the aegis of the Ministry of Agriculture, Government of India — and under the Chairmanship of Sardar Datar Singh—Vice-Chairman of the Indian Council of Agricultural Research,—at which important decisions were taken principally on four aspects of plant protection work in India.

(1) Building up of plant protection organisations—Every Province and State should have adequate plant protection staff; the central Directorate of Plant Protection, Quarantine and Storage should be adequately

staffed to advise and assist the Provinces and States and procure for them insecticides, fungicides and mechanised equipment.

(2) Central Pool.—The Government of India should maintain a central pool of plant protection power-operated machinery in 3 centres, namely Asansol, Ajmer and Nagpur, to serve all parts of the country and the various important insecticide and fungicide and machinery should be rapidly tested by a central organisation to gauge their efficacy in dealing with particular pests and diseases.

(3) Training of personnel.—The Provincial and State Governments having well organised Departments of Agriculture, should train their personnel and that the centre should train the rest of the personnel from other areas not having such departments.

(4) Quarterly Bulletin.—The Plant Protection Adviser should issue a quarterly Bulletin which may later be developed into a monthly bulletin giving an all-India appreciation of the pest and disease situation for the use of plant protection workers.

Indian Botanical Society

At the Annual Meeting of the Society held at Allahabad, the following Office-bearers were elected for the year 1949:—

President: Prof. G. P. Majumdar, Calcutta.

Vice-Presidents: Dr. A. C. Joshi, Hoshiarpur Prof. M. O. P. Iyengar, Madras.

Councillors: Prof. Birbal Sahni, Lucknow, Dr. R. H. Nirula, Nagpur, Prof. Shri Ranjan, Allahabad, Prof. P. Maheshwari, Dacca; Dr. L. Narayan Rao, Bangalore; Prof. Y. Bharadwaja, Jodhpur, Prof. M. Sayeed-ud-din, Hyderabad; Prof. K. C. Mehta, Agra, Dr. B. P. Pal, Delhi; Dr. R. K. Saxena, Allahabad.

Editorial Board: Prof. G. P. Majumdar (Chief Editor), Calcutta; Prof. P. Parija, Cuttack; Prof. A. C. Joshi, Hoshiarpur.

Dr. T. S. Manabali, Royal Institute of Science, Bombay-1, and Prof. S. P. Agharkar, Law College Building, Poona-4, continue to be the Secretary and the Treasurer and Business Manager of the Society respectively.

Unesco Grant to Indian Chemical Society

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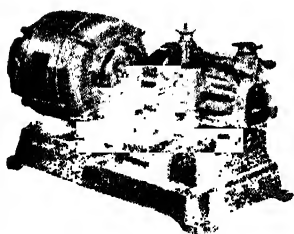
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Current Science

Vol. XVIII]

MARCH 1949

[No. 3

	PAGE		PAGE
<i>Rôle of Engineers in India</i>	61	<i>The Indian Council of the British Empire</i>	
<i>World Scientists Discuss Atomic Chemistry</i>	62	<i>Leprosy Relief Association—Annual</i>	
<i>Atomic Energy Commission</i>	63	<i>Report, 1947. K. P. MENON</i>	67
<i>Isotope Production</i>	63	<i>Colloids in Biology and Medicine</i> ..	68
<i>Animal Husbandry Wing Meeting of the</i>		<i>The Patent System and the Scientist</i> ..	69
<i>Board of Agriculture and Animal Hus-</i>		<i>Obituary—</i>	
<i>bandry (Indian Council of Agricultural</i>		<i>{Dr. Yellapragada Subba Row</i>	70
<i>Research)</i>	64	<i>Sir K Ramunni Menon</i>	71
<i>Improvement in Methods of Dating</i> ..	65	<i>Letters to the Editor</i>	72
<i>A Regional Metallurgical Research Labo-</i>		<i>Reviews</i>	86
<i>ratory for Western India</i>	66	<i>Science Notes and News</i>	95

RÔLE OF ENGINEERS IN INDIA*

IT is an extraordinary fact and unfortunate fact that the enormous resources available in India have not been utilised for raising the standard of the nation. It is clear that with the proper utilisation of the present resources of India we can raise the standard very greatly.

Nevertheless, the fact remains that not only do we not utilise them to the best advantage but we actually waste the existing resources in destructive activities. That is a tragedy of the present generation.

* Extracts from an Address delivered by Pandit Jawaharlal Nehru on 6th December 1948 while inaugurating the 19th Annual Meeting of the Central Board of Irrigation.

Even more so it has been of the past generation. Somehow, we always find in history in the past age and in the present age that there are conflicting forces, forces of construction and forces of destruction. We find this conflict in the attitude of nations towards one another and among groups and ultimately perhaps in the spirit of man himself.

No man can work effectively without faith in himself that the forces of construction are there. Look at the map of Asia and of India. It stares at me in my room in the office. Whenever I look at it many pictures come up before my mind's eye, pictures of the long past history, of the

actual development of man from the earlier stages, of the beginning of culture and civilisation and of agriculture of the early days. Then my attention is concentrated on that huge block of mountains—the Himalayas. Look at them! Can you think of any other part of the world with such a magnificent stretch of mountains with such a vast reservoir of power and potential strength locked up in them! I know of none. How can we utilise it? There are many ways but essentially it is the job of the engineers to tap this vast power. River valley schemes, more or less, scratch the surface and it may be that many generations may pass before we have gone very far in exploiting this tremendous power we have got. In all these, engineers can play a very effective part.

Our task requires the co-operation of a large number of persons. From the top to bottom, if that co-operation is lacking and the spirit of working together is lacking, that job cannot be done properly and is delayed.

We have a very big job to do in this country in every sphere. It is no good complaining of uncomfortable things

happening around us. Since we are born in this period, we have to face them and conquer our difficulties. There is going to be little rest or real peace for us. There are going to be no dividends. The prospect before us is work, hard work. You must divert this hard work into constructive channels.

I do wish the engineers present here to realise that the responsibility of the constructive effort is tremendous and a great deal depends on how they discharge that responsibility and in what spirit they discharge it. I want you to infuse in your work the higher spirit of doing a fine job in fulfilment of certain objectives and ideas. You see ancient structures, mosques, temples. No one knows who built them but anyone can see with his eyes that people who built them were not only fine engineers but men of faith in their work. No one can build such things unless he has faith. We are living in a different age. We do not spend our time in making mosques and temples, but we build many types of public works. I would like you to work with that faith and you will find that if you work in that spirit the results will be great.

WORLD SCIENTISTS DISCUSS ATOMIC CHEMISTRY

DISTINGUISHED world scientists will gather in Britain towards the end of March for a week's conference and interchange of ideas on atomic energy chemical developments.

The gathering, to be held during the week beginning March 28, has been arranged by the Atomic Energy Research Establishment of the British Ministry of Supply in conjunction with the Chemical Society.

The first part of the conference, to be held in Oxford from March 28 to 30, will include a

discussion on the chemistry of the Heavy Elements and on methods of separating radio isotopes.

The latter part will take place in London, and papers will be given on the use of radioactive tracer elements in chemistry, and will include applications in physical, inorganic, organic and bio-chemistry.

The conference will be attended by Fellows of the Chemical Society and by representatives of scientific institutions invited by the Ministry of Supply.

ATOMIC ENERGY COMMISSION

IN view of the fact that the organisation of work in the nuclear sciences in India would require suitably trained scientists in large numbers in the near future, the Atomic Energy Commission recently convened a Conference of some of the leading scientists in the country to consider what steps should be taken to meet this demand. Since the universities would naturally be the proper nurseries for training such personnel, all universities and prominent research institutions were invited to send delegates to this Conference, which met in New Delhi, on the 21st and 22nd January. Prof. H. J. Bhabha, Chairman of the A.E.C., presided over the deliberations. The important decisions reached at the Conference were: (1) Steps should be taken immediately to draw up a uniform and suitable syllabus for the teaching of theoretical and practical physics, mathematics and chemistry in Indian Universities; (2) Refresher courses, like summer schools, should be organised for willing teachers of the universities so that the suggested syllabus may be taught in the universities by them.

By way of implementing the first decision, the Conference appointed a Committee to go into the question of drafting a suitable syllabus for theoretical physics, experimental physics and chemistry going up to the M.Sc. standard which could be easily adopted by the universities without the necessity of radically changing the existing curricula overnight.

The following were nominated on this Committee:—Dr. S. N. Bose, Dr. D. S. Kothari, Dr. R. C. Majumdar, Dr. N. R. Sen, Dr. R. S. Krishnan, Dr. D. M. Bose, Dr. H. J. Taylor, Prof. S. Bhargava, Dr. Mata Prasad, Dr. G. P. Kane, Dr. P. B. Sarkar and Dr. Jagdish Shankar.

The following are the terms of reference of the Committee:—

1. To scrutinize the syllabus of teaching in Physics, Chemistry and Mathematics in the different Indian universities and to make recommendations with the object of bringing these courses to the level of modern standards. The Committee will pay special attention to the inclusion of basic knowledge in each subject which every student should know. The Committee will also draw up more advanced courses for those who specialise in atomic sciences.

2. To circulate the courses drawn up by the Committee to all the universities for suggestions and on receipt of replies, to submit a final report to the Atomic Energy Commission.

3. To examine whether the courses suggested by the Committee can be divided conveniently into under-graduate and post-graduate courses.

4. To submit a preliminary report by the end of February 1949 so that the document could be communicated to different universities well in advance before the commencement of the next academic year.

It may be pointed out the decisions arrived at this Conference called by the A.E.C. when implemented, will constitute a concrete step in organisation and development of the atomic sciences in India. This is perhaps the first time that representatives from all the teaching and research institutions in India have met together to formulate uniform syllabi for physics, mathematics and chemistry for adoption by all Indian universities. It is earnestly to be hoped that the lead given by the A.E.C. will be followed by other groups of sciences.

ISOTOPE PRODUCTION

BBRITAIN'S large atomic pile has just started work on the production of radio-active isotopes.

When operating at full power it will be able to produce all the artificial radio-active isotopes required by medical, industrial and other research workers in the U.K. as well as increased supplies for export, for which a steadily increasing demand is anticipated.

Opened at Britain's Atomic Energy Research Establishment at Harwell in July last year,

the pile has a rated output of 6,000 kilowatts and was designed primarily for experimental purposes. Materials which it irradiates will be 20 times more active than those so far irradiated.

Radio-active isotopes have already been delivered by Harwell to various research institutions, including hospitals, universities and industrial organisations in the U.K. and abroad.

The first deliveries from this large pile will start early in March.

ANIMAL HUSBANDRY WING MEETING OF THE BOARD OF AGRICULTURE AND ANIMAL HUSBANDRY

(Indian Council of Agricultural Research)

THE Eighth Animal Husbandry Wing Meeting, which was held at Mysore during the third week of February 1949, was inaugurated by His Highness the Maharaja of Mysore. His Highness emphasised the part played by the cattle in the economic well-being of this country from very ancient times and outlined the problems facing the country to-day.

This meeting which was presided over by Sardar Datar Singh, was of special significance at this juncture when the balance of cattle wealth has become rather unfavourable due to the partition of the country. The Province of Sind is the home of several important milch herds and as things stand to-day their import has almost ceased. The effect of this is already felt, and *per capita* supply of milk which stood at 5·8 oz. before partition has dropped to 5·2 oz. On the other hand the import of milk products like butter, condensed milk, milk powder and cheese is increasing rapidly day by day. The Wing specially considered this loss to the cattle wealth, and far-reaching suggestions were made to conserve the available stock of animals of all-India breeds. It was proposed to establish large cattle farms of such breeds in suitable areas, creating 'key village' areas to help the multiplication of better quality of cattle, and set up a Special Board with necessary statutory and functioning powers to look after the well-being of the cattle wealth. A closely interrelated proposal was also adopted in the form of setting up of "key village" areas in different parts of every Province and State where intensive cattle-breeding work could be carried out. Shortage of proven sires is the biggest obstacle to cattle development. As things stand to-day only one sire is available where 250 are required. To overcome this obstacle the plan envisages that the available pure-bred bulls should be concentrated in selected key villages taking into consideration the nature of breed most suitable for that area, to cross with the available stock in that area. Simultaneously, steps will be taken to enforce by legislation compulsory castration of bulls in these selected areas. The graded stock produced will be available from the very first generation to grade up the original stock. In the key village area itself the indigenous stock after the fifth

generation will be almost as good as pure-bred stock, and thus work will be gradually extended to other areas, with the result that in course of the time each village could become a breeding centre instead of relying on a few farms as at present. The plan thus aims at improving the existing stock on a much larger scale than is possible just now and may truly be called a milestone in the cattle improvement schemes that have been formulated so far.

The work carried out, with cows and buffaloes, at a few selected centres on artificial insemination has given very promising results. It was therefore proposed that this method should be now utilised widely for improving cattle. In the beginning it will no doubt be necessary to exercise caution and extend the work step by step to avoid disappointments later.

Along with breeding, an equally important problem is to find ways and means of augmenting the present inadequate supply of feeding stuffs for cattle. Shortage of feeding stuffs is one of the biggest obstacles facing the cattle industry, which, if not tackled properly, will upset any plan for cattle improvement and production of more milk. The subject received careful consideration at the meeting and the proposal was made that in view of the fact that at present a large number of cattle live only on the agricultural residues, means should be found to devote a certain portion of the land where irrigation facilities exist and that which the Government is proposing to develop, for growing fodder. Fodder should also be grown by proper rotation on the existing land. Utilisation of leaves and seeds of fruits by processing or otherwise, making use of materials such as entrails, blood, bones, etc., creating fuel and fodder plantations, conserving grass during the monsoon seasons in the form of silage—were some of the methods suggested. It was recommended that the present practice of exporting oil-seeds should be discontinued early and seeds should be crushed in villages so that cakes will be available for use as cattle feed. The practice of extracting oil from oil-cakes by solvent extraction needed to be discouraged as there was no justification for assuming that our cattle get an adequate amount of fat and calories in their diet from other sources. If the use

of oil-cakes for manuring was stopped, wherever possible, that will release considerable quantity of concentrates for cattle. The rôle of trace-elements in animal nutrition is a subject that has not been investigated in any great detail, as also the toxicity of plants consumed by the animals during grazing. It was therefore recommended that these two subjects should be investigated in detail.

The meeting also considered the need for the improvement of cattle in hilly areas and decided to appoint a Special Committee to survey the problem, especially in areas where indigenous breeds fail to thrive.

The Wing suggested steps that should be taken to reduce the mortality amongst young calves, which is a constant drain on some of the potentially best cattle. Apart from the various diseases which are responsible for this heavy loss, it was emphasised that the problem was largely an economic one, and unless breeding of live-stock was made profitable, other remedial measures cannot be expected to bring the desired changes in the existing practices. It was therefore recommended that where possible calf farms should be started where calves

may be reared and looked after properly till maturity. Different practices for rearing of calves are followed in different parts of the country. It was therefore decided to survey these methods so that when the experience of all the breeders is pooled together it may be possible to evolve a cheap method for raising calves.

It was recommended that in view of the growing number of centres where various veterinary biological products are manufactured, and also because of the large import of these products, it was necessary to set up an organisation with statutory powers to lay down standards and check the quality of these products. Such an organisation is overdue and it is hoped that early action will be taken on the lines of the existing Drug Acts from which veterinary products are excluded now.

The question of veterinary education was also discussed. It was emphasised that the standard of training should not only be uniform, but as high as possible. The setting up of an Indian Veterinary Council was recommended to safeguard the interests and integrity of the veterinary profession.

IMPROVEMENT IN METHODS OF DATING*

IN the field of architectural history, the Method of Seriation has uniformly been followed for purposes of dating. With the help of buildings, of which the dates are known from independent evidence, an evolutionary series is first built up; and then temples of which the dates are not known, are assigned dates according to their nearness to one or other of the landmarks in the scale. The assumption in Indian Architecture has been that the whole of India can be treated as one unit in evolution, and that evolution itself has been unilateral. Different workers like Fergusson or Rakhaladas Banerji have only differed from one another in their choice of elements used for building up the scale of reference; but the fundamental assumptions have been uniform.

Professor Bose suggests that this method of treating the whole of India as one evolutionary unit, and the dependence on

unilinear evolutionism is not justified. There is evidence to show that in different regions, temples have followed slightly different courses of evolution. Moreover, the structural elements of temples have also changed, not uniformly, but at varying rates.

Professor Bose has tried to apply the Distribution Method for finding the relative age of those elements. He proposes that, in each region of India, the dated temples should be taken up, subjected to a uniform scheme of analysis, and an independent scale of evolution built up with their help. When this work has been accomplished in different provinces of India, the findings arrived at by a reliance upon the Distribution Method should be compared with the above result. Only then shall we be in a position to assess the value of the latter method, as well as check the results arrived at by previous workers in the field, who relied on a belief in the uniformity of evolution.

Research workers in different areas can thus be of help to one another in bringing more precision into methods of dating.

* Summary of the Presidential Address delivered by Professor Nirmal Kumar Bose, to the section of Anthropology and Archæology during the 36th Session of the Indian Science Congress held at Allahabad, January 1949.

A REGIONAL METALLURGICAL RESEARCH LABORATORY FOR WESTERN INDIA

AN IMPASSIONED plea for the establishment of a centre for industrial metallurgical research to meet the industrial needs of Western India was made by Prof. N. P. Gandhi in the course of his address before the Bombay Metallurgical Society, at Bombay. Every metallurgical factory, he said, must needs get problems to solve from time to time. "Sometimes a furnace is not giving the required temperature; sometimes the fuel or energy consumed is excessive; sometimes the refractory material fails in an unaccountable manner; sometimes the metal produced has too many blow-holes or other defects; sometimes the metal cannot be rolled well; sometimes the dies, rolls, etc., wear too quickly or break too often; sometimes the rejection of castings is too great to leave a margin of profit; sometimes a tool or machine part is not functioning properly due to faulty heat treatment; sometimes a metal is oxidising badly, and so on. Scores of such instances will occur to most factory workers. How are these problems to be solved? By shutting our eyes to them? By blaming ill-luck? By putting up with them as something mysterious or unsolvable? No. They can be investigated into. In most cases a clue and a way out can be found at a sufficiently low cost. Only we must have a testing laboratory, a band of investigators and the will and perseverance to solve.

Most small factories cannot afford to have a research laboratory of their own. They would probably have more technical problems to solve than the larger factories. Even if they can afford the equipment, they cannot afford the salary of a whole-time staff. What then are they to do? The answer is: Co-operate with other factories in the trade. Here comes in the question of competition. One factory owner often does not want the others to know what his problem is and what solution he has found for it. Can this necessary secrecy be safeguarded in a research laboratory put up jointly with others in the trade? The answer is: yes. If you ask how, here is an answer.

Suppose 20 factories in a trade jointly raise a sum of two lakhs of rupees for a co-operative industrial research laboratory. (Nowadays amounts can be contributed

for such projects free of income-tax.) It is likely that the Government will make a contribution of an equal amount towards such an effort. But suppose that the Government contributes only half, i.e., one lakh of rupees. This will make it three lakhs. A building can be hired at first. About two lakhs of rupees worth of equipment can be installed, including machines for testing tensile strength, hardness, impact resistance, fatigue, corrosion, etc., an analytical laboratory, a metallographic laboratory, pyrometers both indicating and recording, Orsat apparatus, carbon dioxide recorders, heat treatment apparatus, a small workshop and a library. The industry would have to pay a small cess on its sales to meet the cost of a small permanent research staff consisting of 3 or 4 members. When not engaged in solving any particular firm's problems, the small permanent research staff can remain busy solving general problems pertaining to the industry as a whole. Attached to the research laboratory there should be a certain number of vacant rooms having separate entrances and fitted with gas, water, electricity and laboratory furniture. Any member-firm wanting to solve a problem can hire one of the vacant rooms for a period and borrow or have access to the necessary equipment and stores in the common stock. It should be open to the firm to make use of the permanent research staff on partial payment if it so desires. It should be likewise be open to the firm to bring its own staff for solving its problems either from its own factory or specially recruited by it for the purpose, or both. It should only be necessary for the research department to see that the staff brought is sufficiently qualified to use the borrowed equipment properly. At the end of the work the borrowed equipment and stores are to be returned. No charge should be made to the firm for the common capital equipment used for the research. The only charge should be in respect of the stores and energy consumed and for any damage caused. The firm need not divulge what problem it investigated and with what results.

The cost of solving a problem in such a manner would only be a fraction of what the firm would have to spend if it was to

buy all the necessary instruments, apparatus, etc., fit up a temporary laboratory for the research, dismantle it and dispose of it when the work was over. If the scheme of co-operative industrial research succeeded, more money would flow in and further

equipment such as a spectrograph, a polarograph, an X-ray unit, etc, could be added and even a permanent building put up. If it failed, there would probably be little difficulty in disposing of the standard units of the equipment.

THE INDIAN COUNCIL OF THE BRITISH EMPIRE LEPROSY RELIEF ASSOCIATION—ANNUAL REPORT, 1947

THE All-India Leprosy Workers Conference, the first of its kind in India, held its successful session in Wardha. The increasing interest taken by Provincial Governments in anti-leprosy work was highly gratifying. The research activities were conducted in collaboration with the Endowment Fund of the School of Tropical Medicine, Calcutta, and the Indian Research Fund Association. The summary of the researches included:—

1. *Therapeutic studies:* Sulphones, Promins and diasone, in leprosy, were found to yield some results in certain cases of lepromatous cases with ulcers and eye-complications and in those who cannot stand injections of hydnocarpus oil. The drugs mark a definite advance in the treatment of leprosy.

2. *Clinical Study:* A study on the eye-lesions in leprosy has been completed the useful data collected indicating two main types of eye-lesions in leprosy. 200 cases were studied of which 116 were neutral cases; of these 92 were bacteriologically negative, 24 positive, only two cases had complete loss of sight in one eye. Of 80 lepromatous cases examined, 58 were fairly intensive, 22 advanced, complete loss of sight was noticed only in two cases. This finding indicates that eye-lesions in leprosy in India is a rare condition.

3. *Bacteriological studies:* Dr Rao's claim for successful cultivation of *M. lepræ* in symbiosis with leishmania culture could not be confirmed.

4. *Transmission of leprosy by cockroaches:* Dr. Moiser, a Rhodesian leprosy worker suggested that cockroaches are responsible for transmission of leprosy, but this view could not be confirmed by results of the experiment carried out at the School of Tropical Medicine, Calcutta.

Useful findings were obtained in a correlation study of clinical, bacteriological

and immunological aspects of leprosy. Other activities included teaching and routine clinical work.

Among the Provincial branches the scope of the work was enormously widened in Madras. There were 12 important inpatient institutions in the Province besides facilities for admission and treatment in different Headquarters hospitals. In the field of investigation, child leprosy received considerable attention. In Saidapet, a Child Clinic was established exclusively for child leprosy enquiry and valuable data regarding incidence of the nature of the disease were collected. It was elicited that the majority of leprosy cases in children under ten years formed a group of 'prelepromatous leprosy' or incipient lesions of childhood. They were kept under observation without treatment and most of them showed spontaneous improvement. It was also found that the closer and more prolonged the contact with leprosy cases, the more serious the form of the resulting disease. Another valuable observation was that the incidence of leprosy was decreasing in villages where night segregation of infective patients was enforced and increased in the corresponding groups of villages where there was no night segregation. In the survey work in the endemic districts it was found that in the highly endemic area child-rate varied from 10% to 73.8% of the total cases. In the sphere of treatment with sulphone group of drugs there was some promise in certain type of cases as was previously observed. Some ayurvedic remedies reported to be of use in leprosy were tried without encouraging results. The Provincial Government, the Indian Council of British Empire Leprosy Relief Association and Mission Institutions have share in the Anti-Leprosy campaign in the Province.

K. P. MENON,

COLLOIDS IN BIOLOGY AND MEDICINE*

THE address deals with certain aspects of colloid chemistry with special reference to biological processes. Colloids offer a fruitful meeting ground for the different branches of Science; its manifold applications not only to industry but also to biology and medicine have made it of vital importance to the biologist and the physiologist. Colloid technique offers powerful tools to probe into the nature of isolated growing cells and tissues and leads to a better understanding of the types, the mechanism of sub-division, their movements and the factors affecting the nutrition of cells, muscle, and blood. A purely biological approach to the study of these problems is inadequate. A typical instance in point is the study of the protoplasm. Protoplasm has been defined as the material basis of life and it is only when the knowledge of the biologist on its behaviour, the results of the chemist regarding its constitution, investigations of the Colloid chemist on the state of dispersion and aggregation and the experience of the physicist regarding energy propagation in an essentially dynamic system are all woven together that a fabric giving a comprehensive picture can be obtained. Predominant colloid characteristics like electric charge, cataphoretic migration, iso-electric point, coagulation, peptization, adsorption, and membrane permeability have been shown to play a fundamental rôle in most vital processes. There is thus a clear indication that the future development of colloids will be mainly in its application to living matter and life processes.

An interesting aspect of the subject is the study of the formation of structures like muscle fibres, bones, gall-stones, etc., in the living organism. These structures are closely related to periodic precipitation in gels. Similar physical conditions regarding diffusion, supersaturation, presence of a gel medium, formations in a colloidal state, are operative in both cases, and thus it becomes possible to explain the genesis of gall stones and other growths in the animal body in the same manner as in the

formation of periodic precipitates. Thus, during inflammatory conditions, cholesterol in animal body separate along with calcium bilirubinate as a colloidal mass in the first instance. These change to a crystalline form by a process which is analogous to crystallization in a gel and thus concentric deposition, which is characteristic of reactions in a gel, is produced. The formation of shells, mother of pearl, and various types of concretions have many points of similarity with periodic precipitation. Synthetic elements produced by slow decomposition of calcium bicarbonate held in a gelatine gel give fine periodic layers of calcium carbonate with a spacing of about 4000—6000 per cm. and display the colours of natural mother of pearl. It may be considered that the alternate layers of aragonite and conchioniline in the mother of pearl are formed by a process of periodic precipitation.

Radiations act variously on colloids. They may lead to periodic deposition, photophoresis, and changes in the state of dispersion resulting both in a finer sub-division of the particles and in coagulation. Photoelectric effects may take place followed by secondary effects like increase in conductivity and decrease in viscosity but in many cases the behaviour is better explained on the basis of photochemical changes which alter the conditions of the protecting layer and thereby reduce or neutralise the charge on the particle. These experiences from the study of colloids *in vitro* have their significance in the use of irradiations *in vivo* which affect colloidal materials of the living body.

The behaviour of colloids towards light is linked up with several branches of actino-therapy particularly in relation to deficiency and metabolic diseases. Though the emphasis in the therapeutic use of radiations has been more on the physiological side, a colloid-chemical approach to the subject is bound to prove profitable.

Adsorption offers another point of contact between colloid phenomenon and biological processes. There is no dearth of experience where the cells of the living body act as adsorbent. The role of adsorption is enhanced by the highly disperse nature of the body materials and

* Abstract of the Presidential Address of Dr. P. B. Ganguly, delivered before the section of Chemistry during the 36th Session of the Indian Science Congress, held at Allahabad, Jan, 1949.

the existence of minute capillary spaces. The catalytic activity to enzymes is intimately connected with adsorption. Experiments with inorganic adsorbents have shown that the molecules in the adsorbed layer are oriented in characteristic manner. A similar process is considered to be operative in the case of enzymes, where the peculiar frame work of the adsorbed molecules resulting from orientation will produce a factor of specificity in their action. There is a clear parallelism between toxicity and adsorption, which also lies at the basis of many biological phenomenon.

Peptisation and flocculation are essential properties of colloidal systems. These principles find their applications in the diagnosis of certain diseases and the pathological examination of body fluids. It has been found advantageous to use many

medicines in a colloidal form rather than as ionogenic salts. Such a method of administration of a medicine secures a low osmotic activity and a large surface. Thus, medicine in all its aspects has made free use of colloid chemical methods.

There are many other spheres of biological activity where colloids play an important part. Again and again we find predominant colloidal characteristics like electric charge, cataphoretic migration, iso-electric point, coagulation, peptisation, adsorption, membrane permeability and many others, playing a fundamental rôle in most vital processes. Life is a continuance of the colloidal state and coagulation means death. As cytology marches onwards, many a chapter of the interplay of colloid behaviour and life processes will be revealed.

THE PATENT SYSTEM AND THE SCIENTIST*

IN the course of a thought-provoking article stressing the need for Scientists in India to pay greater attention to the Patent System than they have done hitherto, Sri. K. Rama Pai observes that Society looks up to the Scientists not only to expand the frontiers of knowledge, but also to solve numerous problems which face it, such as the economic problem of finding food and employment, the defence problem of maintaining an adequate war potential which would ensure freedom to the nation, and a thousand and one other problems which would assist men in passing through life with maximum comfort, and that the Scientist has a duty to concern himself with every factor which would be helpful to him for adapting his discoveries in the field of applied research, for utilitarian purposes.

Explaining the advantages of the Patent System, he remarks that it has been designed to encourage inventors to develop inventions from the laboratory stage to the industrial stage.

* Abstract of an article on "Patent System and the Scientist" by Sri. Rama Pai, Secretary of the Patents' Enquiry Committee, constituted by the Government of India, to the symposium on Patent System arranged at the 36th Session of the Indian Science Congress.

Commenting on the present attitude of the average Scientist in India to the System of Patents, he says that, as a rule, the Indian scientist either views the Patent System with positive disfavour or is supremely indifferent to it, as a result whereof many inventions of great merit which were known in the past have been lost to the country, or, the resources of research have been utilised unfortunately for re-inventing what has already been invented by others.

By way of breaking down the popular prejudice on the subject, Sri. Rama Pai argues that while it is true that the Patent system gives a formal recognition to the inventor of his exclusive right to his invention, this is done only in exchange for two privileges surrendered by the inventor, namely,

- (i) The prompt disclosure of the invention to the public ; and
- (ii) The unreserved dedication of the invention to the public on the expiry of the Patent.

What the Patent System actually does therefore is merely to restrict the period of exclusive right to a reasonable period of 16 years. There can be no doubt that in this transaction it is the public who get the better of the bargain in the long run.

OBITUARY

DR. YELLAPRAGADA SUBBA ROW

THE American press has paid glowing tributes to the work and achievements of Dr. Yellapragada Subba Row, noted Indian physiologist and Director of Research for the Lederle Laboratories Division of the American Cynamid Company, who died recently at his home in Pearl River, New York, at the age of 52.

"In the death of Dr. Subba Row," says the *New York Times*, "medical research has lost one of its commanding figures". Few laymen, the paper says, knew directly of Dr. Subba Row's work—his contributions to the control of certain types of anæmia, his researches in nutrition and his investigations of drugs—but "many advances in modern medicine stand as monuments to his genius and countless thousands will benefit for years to come from investigations he set in motion and supervised".

Dr. Subba Row, according to the *New York Herald Tribune*, was regarded by many scientists as "one of the most eminent medical minds of the century". He was interested in everything from liver extracts to orchids and his work in the last twenty-five years carried him to "pinnacles reached by few medical investigators".

Born in Madras, Subba Row received his Bachelor of Medicine and Master of Science degrees from the Madras University and then took the degree of Doctor of Tropical Medicine from the University of London. He went to America in 1923 and later became an American citizen.

He was a Harvard University Fellow from 1925 to 1928 and a Rockefeller Foundation Fellow from 1928 to 1930. For a period he was an orderly at Peter Bent Brigham Hospital. His work done, he would return to his laboratory where he and other medical students would sit far into the night discussing problems in chemistry and related fields. At Harvard he studied Biochemistry under the late Dr. Otto Folin and eventually took a Ph.D. degree in the subject.

In 1936 Dr. Row became an instructor and in 1938 an Associate Professor of Biological Chemistry at the Harvard Medical School. In 1940 he was appointed Associate Director of Research for the Lederle Laboratories. Two years later he became the Research Director.

Among Dr. Subba Row's important researches were investigations which helped to revolutionise the modern concept of muscular contraction. He evolved new methods of phosphorus determination which helped to lead eventually to the discovery of organic phosphorus compounds in muscle. This discovery has thrown new light on the mechanism of muscular contraction. He also won distinction by isolating certain liver factors which resulted in the development of such products as folic acid, teropterin and other drugs. Further research in the folic acid compound led to the discovery of a number of substances related to it, like Vitamin M, Vitamin BC, Vitamin B-10, B-11 and others. These researches produced a new approach to the treatment of cancer and pernicious anæmia through nutrition.

Dr. Row aided the production of penicillin and streptomycin in large quantities during the war. He and his associates also produced the wonder drug auriomycin used in the treatment of infections which do not respond to penicillin or streptomycin. Another major achievement, one of his last, of Dr. Row was the perfection of a new specific—Hetrazan—for the cure of filariasis, a tropical disease, said to be affecting some 20 crores of people in India, Far East, North and Central Africa.

Always eager to learn, Dr. Row's curiosity was insatiable. Three years ago he decided he would systematically examine the world around him to fit together a few missing pieces in his experience. He learnt to drive an automobile. Then he learnt to ride horse. Then he learned to fly an aeroplane; won his license and made a number of solo flights. Then he became interested in bowling and tried to work out the most efficient methods of scoring strikes on the bowling alley. And in recent months he had focussed his attention on orchids and was trying to devise new ways to make them grow faster.

Dr. Subba Row, says the *New York Times*, was one of those remarkable individuals who, from time to time, becomes seriously worried about his ignorance and tries to do something about it. "Matched against the average person, or indeed the average

member of the medical profession and allied sciences, Dr. Subba Row might well have qualified as a repository of universal knowledge. But that would not

have satisfied him. He yearned to know more."

Surviving are his mother, a sister and a brother, all residing in India.

SIR K. RAMUNNI MENON

DIWAN Bahadur Sir K. Ramunni Menon, M.A. (Cantab.), LL.D. (Madras), passed away on 14-1-1949. He was born at Trichur on 14-9-1872. He was educated in the Maharaja's College, Ernakulam and later in the Presidency College, Madras. He went to England for higher studies in Zoology and joined Christs College, Cambridge. When he returned to India, he was appointed to the Madras Educational Department in 1898. He became Professor of Zoology in the same College in 1910 and continued in that capacity till 1927 when he retired. In a College which was noted for discipline in those days Prof. Ramunni Menon's Department held the field. His lectures on the most difficult subjects in Zoology were characterised by lucidity of expression. He loved to see his students do their practical work with cleanliness and accuracy. He was keen on research and for several years interested himself in the study of certain forms of coelenterates. He was cautious to a degree with the result that he was not able to produce that amount of research work that one might have expected. His administrative duties also weighed him down and he could not devote enough time to his research work. He himself felt this and this in a way made him anxious to create conditions for others which would enable them to make substantial contribution to Zoology in South India. This idea took firm possession of him about the year 1927 when he began to think seriously of establishing University research laboratories not only for Zoology but also for Botany and Biochemistry. He planned out the three laboratories and as Vice-Chancellor of the Madras University during 1928-34, he was

able to put through the scheme and had the satisfaction of seeing its completion before he laid down office. It is to his great exertion and forethought that we have these three research laboratories. Zoology in South India owes a great debt of gratitude to him.

The new University buildings were also completed during his term of Vice-Chancellorship. It has been said with justice that this fine pile of buildings has been due to a great extent to the way in which he husbanded the resources of the University before and during the construction of the buildings. He was nominated life-member of the Senate of the Madras University. He was also nominated member of the Madras Legislative Council on two occasions. He represented the Madras University at the Congress of the Universities of the Empire at Edinburgh, in 1931. He was Chairman of the Inter-University Board, 1932-33, and member, Council of State, India, from 1934 till the Council was dissolved.

Sir K. Ramunni Menon was not one of those people who courted lime-light. His field rather lay more particularly in honest unostentatious work. He believed in hard work and expected others to put forth their very best endeavour. He was conservative in his views and believed in the orderly development of society.

After retirement he interested himself in music and the study of Samskrit. He loved his native tongue, Malayalam. He lived a very useful and strenuous life and those who know him well, his students and others, will always remember him with respect and hold him in great esteem.

R. G.

LETTERS TO THE EDITOR

	PAGE		PAGE
<i>The Band Spectrum of Chromium Chloride</i>		<i>Post-Embryonic Development of Antennæ</i>	
—V. RAMA KRISHNA RAO	72	in Aphids—K. N. TREHAN AND	
<i>Vanadimetry—Part I—G. GOPALA RAO AND</i>		H. L. KULKARNY	78
J. V. S. RAMANJANEYULU	72	<i>Dimorphism in Stamens of Crotolaria</i>	
<i>Reduction of Nitro Group to Amino Group</i>		juncea—N. K. ANANT RAO AND OM	
by 'Hydro' in Alkaline Medium—		PRAKASH GAUTAM	80
G. G. JOSHI AND N. M. SHAH	73	<i>Feeding Methods of the Cotton White-Fly</i>	
<i>p-Cymene from Carenes—JAMES VERGHESE,</i>		—S. P. CAPOOR	82
H. K. SONDHI, BHARAT BHUSHAN AND		<i>Production of Oospores by Sclerospora</i>	
M. L. JOSHI	74	sorgi on Maize—M. K. PATEL	83
<i>A New Synthesis of p-Aminosalicylic Acid</i>		<i>Dolichos biflorus L.—A New Host of</i>	
—M. RAGHAVAN, B. H. IYER AND P. C. GUHA	75	Xanthomonas phaseoli Sojense (Hedges)	
<i>Dielectric Constant of Ionic Solids—</i>		Dowson—M. K. PATEL, Y. S. KULKARNI AND	
S. K. K. JATKAR AND (MISS) S. B. KULKARNI	76	G. W. DHANDE	83
<i>On the Preparation of Paludrine (Proguanil)</i>		<i>A Remarkable Abnormality in the Develop-</i>	
—H. L. BAMI	77	ment of Viviparus dissimilis (Muller)—	
<i>The Development of a Harpacticoid</i>		R. V. SESHAIYA	84
Copepod, Macrosetella gracilis (Dana.)		<i>Carpet Beetle Damage to Telephone Wires</i>	
—S. KRISHNASWAMY	78	—M. APPANNA	85

THE BAND SPECTRUM OF CHROMIUM
CHLORIDE

THE band spectrum of Chromium Chloride which is prepared for the purpose, using a pure 'Kahlbaum' specimen of chromium, has been excited in the heavy current generator discharge maintained at 1500v, 1 A., in a specially designed quartz discharge tube. Five prominent groups of bands are obtained in the region λ 6400-5700. The bands are line-like and appear very similar to the system of $MnCl$, obtained in our laboratory, in the region λ 4000-3600. The bands show a complex intensity distribution, and are assigned to the electronic transition ${}^6\pi-{}^6\Sigma$, involving high multiplicity terms. The average separation between the components of the ${}^6\pi$ level is obtained as 44 cm^{-1} , and the values of the vibrational frequencies for the lower and the upper states are :

$$\omega_e'' = 291\text{ cm}^{-1}$$

$$\omega_e' = 362\text{ cm}^{-1}$$

Details will be published shortly.

Andhra University, V. RAMA KRISHNA RAO.
Waltair,
February 18, 1949.

VANADAMETRY—PART I

*Volumetric Estimation of Ferrous Salts in
the Presence of Alcohols*

Viswanadham and Gopala Rao¹ have shown that the reaction between ferrous salts and chromic acid induces the reaction between oxalic acid and chromic acid; if a solution of potassium dichromate is employed for the volumetric estimation of ferrous salts in the presence of oxalic acid, the amount of dichromate consumed will be found to be too high. Citric acid has also been shown to interfere by a similar induced mechanism. Gopala Rao and Viswanadham² have shown that the estimation of ferrous salts in the presence of oxalic and citric acids can be accurately carried out by titration with a solution of sodium vanadate.

Extensive investigations have now been initiated to demonstrate the wider application of sodium vanadate as a volumetric reagent and to bring out its exclusive features, if any, when compared with other reagents. We have now found that ferrous salts cannot be accurately estimated by potassium dichromate in the presence of alcohols like methyl, ethyl, isopropyl and *n*-butyl alcohols, the values obtained

being too high. This has been shown to be due to the fact that the reaction between ferrous salt and chromic acid induces the reaction between the alcohols and chromic acid. The excess dichromate solution consumed depends upon various factors, such as the speed of titration, the relative concentrations of ferrous salt and alcohol, the acid concentration, etc. The results recorded in the following table show that the estimation of ferrous salts in the presence of alcohols can be made with accuracy by using a standard solution of sodium vanadate in place of the dichromate solution.

TABLE I

Composition of solution		Amount of ferrous iron found by dichromate method	Amount of ferrous iron found by author's method
Amount of ferrous iron taken	Amount of alcohol solution		
milli mols.	milli mols. of	milli mols.	milli mols.
	methyl alcohol		
0.2259	10.0	0.2596	0.2260
0.4517	10.0	0.5070	0.4518
0.4517	25.0	0.5596	0.4518
0.9034	10.0	0.9713	0.9036
	milli mols. of ethyl alcohol		
0.2397	20.0	0.2887	0.2384
0.4793	20.0	0.5720	0.4792
0.4793	50.0	0.6596	0.4792
0.9586	20.0	1.008	0.9560
	milli mols. of isopropyl alcohol		
0.2160	30.0	0.2352	0.2159
0.4319	30.0	0.4511	0.4319
0.4319	75.0	0.4840	0.4319
0.8638	30.0	0.8913	0.8638
	milli mols. of <i>n</i> -Butyl alcohol		
0.2186	20.0	0.2411	0.2188
0.4319	30.0	0.4511	0.4319
0.4319	75.0	0.4840	0.4319
0.8638	30.0	0.8913	0.8638

Sodium vanadate has thus some special advantages over potassium permanganate and dichromate as a volumetric reagent. It can be used for the estimation of ferrous salts in the presence of oxalic acid, citric acid and the alcohols, where potassium permanganate and potassium dichromate give too high results. Moreover, sodium vanadate solutions can be easily prepared and preserved over long periods without change in titre, unlike potassium permanganate. Ammonium vanadate supplied by Schering Kahlbaum, Merck or B. D. H. has been found to be quite pure. The requisite

quantity of the salt is weighed out carefully into a conical flask, dissolved in distilled water, a slight excess of pure sodium carbonate added and the solution boiled until all the ammonia is driven out. The resulting solution is cooled and transferred to a litre measuring flask and made up to the mark. The strength of the solution is checked up by titration against a standard solution of ferrous ammonium sulphate, using diphenylamine or diphenyl benzidine as internal indicator. A standard solution of sodium vanadate prepared in this way is remarkably stable, especially when containing a slight excess of sodium carbonate, about 0.1 per cent.

Detailed results are being published elsewhere.

G. GOPALA RAO.

J. V. S. RAMANJANEYULU.

Andhra University,

Waltair,

November 20, 1948.

1. Viswanadham and Gopala Rao, *Curr. Sci.*, 1943, 12, 327. 2. —, *Ibid.*, 1944, 13, 180.

REDUCTION OF NITRO GROUP TO AMINO GROUP BY 'HYDRO' IN ALKALINE MEDIUM

THE aromatic amino compounds are useful substances in synthesis as well as in industry. They are prepared by the reduction of the corresponding nitro compounds, the reducing agent used generally being a hydrogen-generating combination of metal and acid; the other reducing agents lead either to the production of hydroxylamines, azoxy or azo compounds.¹ Electrolytic reduction also gives different products depending upon the conditions used.²

In connection with other synthetic work, certain amino compounds (e.g., 5-amino-salicylic acid, 6-aminocresol, etc.) were required in quantity. The usual reduction by means of tin and hydrochloric acid did not lead to the desired product in satisfactory yield. Sidgwick and Callow have obtained *p*-amino phenol by incipient sodium hydro-sulphite using sodium sulphite and zinc.³

We thought of using sodium hydro-sulphite (hydro) ($\text{Na}_2\text{S}_2\text{O}_4$) directly as it is easily available and is being used in industry for the reduction of anthraquinone and indigoid derivatives to leuco compounds.⁴ The preliminary experiments were tried and the reduction yielded the

amino compound in excellent yield. It was then considered worthwhile to explore this method of reduction of nitro compounds with a view to its suitability as a general reducing agent for the production of amino compounds from the corresponding nitro derivatives.

Grandmougin⁵ has used it as a convenient reducing agent in connection with azo compounds. He has also tried it in the reduction of compounds other than those containing azo group. He obtained aniline in very poor yield by the reduction of nitro-benzene by this method and therefore he did not prefer it.

We have now investigated the reduction of several nitro compounds substituted as well as unsubstituted by means of hydro in 50% alkali solution. In all the cases (except nitro-benzene) we have been able to reduce the nitro compounds to the corresponding amino compounds in yields varying from 50-75%. The reaction is smooth and no elimination of the group takes place as recorded in literature in some cases.⁶

The general method of reduction is outlined below:

In a round-bottomed flask of suitable size with a mechanical stirrer, nitro compound (1 mol.) was suspended in water (nearly five times the quantity of the nitro compound) and was gradually heated with stirring to 55-60° C. Sodium hydroxide (50%) solution was added in slight excess; the sodium salt separated in case of phenols and hydroxy acids; finely powdered hydro (3.3 mols.) was added in small instalments (2-3 grams) at a time with continuous stirring. First, the sodium salt if any went into solution: the colour of the charge underwent different changes as the reduction proceeded. Finally, nearly colourless solution was formed indicating the completion of the reduction. The reduction generally takes about an hour or so. In order to ensure the completion of the reaction, the stirring was continued for half an hour more. The unchanged hydro was then filtered off. The filtrate was exactly neutralised by an acid when the amino compound usually separated out. The reduction product obtained was purified and its identity established either by mixed melting point or by preparing its functional derivatives.

In all, fifteen different nitro compounds

have been thus successfully reduced to the corresponding amino compounds.

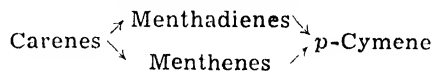
The full details of the paper will be published separately.

M. R. Science Institute, G. G. JOSHI.
Gujarat College, Ahmedabad, N. M. SHAH.
January 8, 1949.

1. Gilman and McCracken, *J. Amer. Chem. Soc.*, 1929, **51**, 821; Fry and Cameron, *J. A. C. S.*, 1927, **49**, 865. 2. Dey, Govindchari and Rajagopalan, *J. Sci. Ind. Res.*, 1946, **4**, 559, 637; *ibid.*, **5**, 75; Kondo and Nakjima, *J. Pharm. Soc. Japan*, 1922, 355. 3. Sidgwick and Callow, *J. Chem. Soc.*, 1924, 522. 4. Rogers, U. S., 1929, 1721, 319. 5. E. Grandmougin, *Ber.*, 1906, **39**, 2495; *ibid.*, 1906, **39**, 3561; 4384. 6. G. Ghiemetti, *Farm. Scie. e tech.*, 1948, **3**, 51; C. A., 1948, **42**, 4553.

p-CYMENE FROM CARENES

INTRODUCTION: Though the disproportionation of carenes into *p*-Cymene is represented by the simple equation $C_{10}H_{16} \rightarrow C_{10}H_{14} + H_2$, the mechanism involved in the aromatisation is far more complicated. The fission of the trimethylene ring in the carenes leads initially to the formation of hydrocarbons which have the same carbon framework in the nucleus as of *p*-Cymene^{1,2}. Subsequent ejection of hydrogen gives *p*-Cymene. Neglecting hydrogenolysis and other secondary processes, and also of the possibility of arriving at *p*-Cymene by the migration of the isopropyl chain of the *o*-derivative^{3,4}, the reaction series from carenes to *p*-Cymene may most simply be represented by the following scheme:



This is an investigation on the possible technical production of *p*-Cymene by vapour phase dehydrogenation of carenes of the Indian turpentine oil, *P. longifolia*, using silica gel as catalyst.

Experimental: Vapours of carenes (b.p. 163-68° C./745 mm., d_{40}^{25} : 0.8468, n_D^{20} : 1.4716, $[\alpha]_D^{25}$: 21°-42°) are passed over the catalyst bed in the pyrogenic unit previously described^{5,1} at temperatures varying from 300-450° C. and at an hourly liquid space velocity of 0.14.

Preparation of the Catalyst: Ferrous sulphate (100 gm. in 500 ml. water) is stirred into sodium silicate (d.: 1.32; 100 gm. in 600 ml. water) until the precipitation is comple. Washed the precipitate several times with water, and then decomposed by

dilute sulphuric acid with gentle heating. The silica thus formed is washed with water free of sulfate, dried 12 hours at 100–110° C., and finally dehydrated 3 hours at 350° C. in the reaction furnace. Pieces of the catalyst 8–10 mesh size are used in the pyrolytic experiments.

In the table is given the results obtained at different temperatures after a single pass of carenes over the catalyst.

Pyrolysis temperature $\pm 15^\circ$ C.	<i>p</i> -Cymene		
	%	d_{15}^{15}	n_D^{20}
• 300° C. ..	24.8	0.8590	1.4829
350° C. ..	23.0	0.8592	1.4839
400° C. ..	25.0	0.8602	1.4869
450° C. ..	16.3	0.8683	1.4934

Thus it appears that in the vicinity of 400° C. there is the optimum conversion of carenes into *p*-Cymene.

Tech. Chem. Laboratory, JAMES VERGHESE.
Forman Christian College, H. K. SONDHI.
Lahore, BHARAT BHUSHAN.
February 1, 1949. M. L. JOSHI.

1. Sondhi, Bhushan, Gulati and Joshi, *J. Indian. Chem. Soc.* (Ind and News Ed.), 1947, **10**, Nos. 1 and 2, 17. 2. Sondhi, Bhushan, Gulati and Joshi, *ibid.*, 1947, **10**, Nos. 1 and 2, 24. 3. Zelenski and Lewina, *Ann.*, 1929, **476**, 60. 4. Guha, Roy and Paul, *J. Indian. Inst. Sci.*, 1944, **26A**, 1. 5. Vergheese, Bhushan, Gulati and Joshi, *J. Indian. Chem. Soc.* (Ind. and News Ed), 1944, **7**, No. 2, 93.

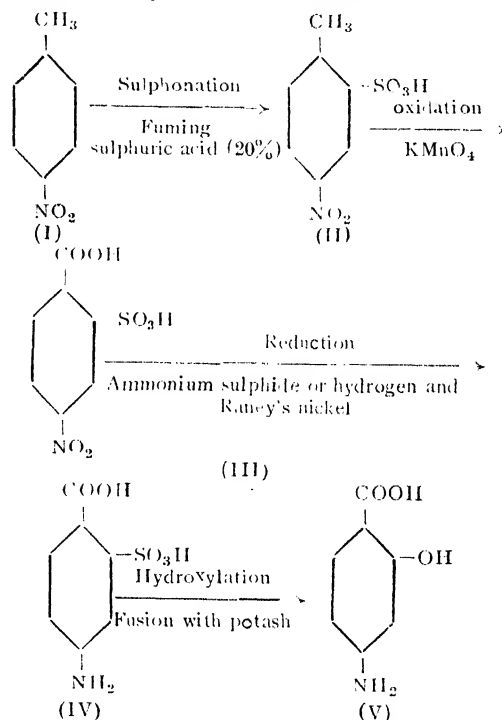
A NEW SYNTHESIS OF *p*-AMINO-SALICYLIC ACID

THE preliminary communication of Lehmann¹ on the treatment of human tuberculosis with *p*-aminosalicylic acid led many chemists and pharmacologists to undertake a detailed study of this acid. Since then *p*-aminosalicylic acid has gained considerable importance in the chemotherapy of tuberculosis.² Clinical experience with the acid has amply confirmed Lehmann's findings and has shown that the acid which is well tolerated by man is remarkably effective in the treatment of pulmonary tuberculosis and of tubercular empyæma.³

p-Aminosalicylic acid⁴ is prepared by the reduction of *p*-nitrosalicylic acid, which itself is prepared by a number of methods.⁵ All these methods are very tedious and as such alternative methods have been investigated for its preparation.⁶ Most of

these involve direct carboxylation of *m*-aminophenol using modified Kolbe's method, giving *p*-aminosalicylic acid and not *p*-hydroxy-anthranilic acid.

Our scheme of work for the synthesis of *p*-aminosalicylic acid is as follows:—



p-Nitrotoluene (I) is sulphonated with fuming sulphuric acid (20%) to yield 2-methyl-5-nitrobenzene sulphonic acid (II).⁷ The potassium salt of this acid is oxidised with dilute permanganate solution (4.3%), to the corresponding 4-nitro-2-sulphobenzoic acid (III).⁸ This on reduction with ammonium sulphide⁹ or with hydrogen and Raney's nickel (150 lbs. p.s.i.) gives 4-amino-2-sulphobenzoic acid. In all these operations the yields are almost quantitative. Alkali fusion, carried out for the first time now, of the dipotassium salt of 4-amino-2-sulphobenzoic acid (IV) at 250° C. gives about 50% yield of *p*-aminosalicylic acid (V). The details of the fusion experiment are as follows.

The dipotassium salt of 4-amino-2-sulphobenzoic acid (IV) (10 g.) which has been thoroughly dried was added in small lots to hot molten potassium hydroxide (20 g.) in a nickel crucible maintained at a temperature of 250–60° C. The fusion mixture was well stirred during the reaction. The reaction was over in about 4

minutes. The cold melt was leached with water (100 c.c.) and the solution was filtered. The filtrate was chilled to about 10° C. and acidified with hydrochloric acid till it was acid to congo red. The aminosalicic acid which had separated was extracted with ether and ether extract dried with anhydrous sodium sulphate. On removal of ether the acid separated out as a light cream coloured powder; yield 2.8 g. The acid was crystallised from alcohol, m.p. 145-46° (decomp.). Hydrochloride m.p., 220-21° (decomp.). Found: N, 9.0, 9.2; C₇H₇O₃N requires 9.15%.

When fusion was conducted using solid paraffin (20 g.) as a diluent, almost the same yield of *p*-aminosalicylic acid was obtained. The acid gives a purple colouration with alcoholic ferric chloride and liberates carbon dioxide from sodium bicarbonate solution. The acid is sparingly soluble in water and moderately soluble in cold alcohol and ether. On heating, the acid gets decarboxylated to *m*-aminophenol. These findings are interesting when viewed in the light of the observation of J. A. Connor¹⁰ that aqueous solution of *p*-aminosalicylic acid or its hydrochloride is decarboxylated to *m*-aminophenol at temperatures above 80° C.

Attempts to hydroxylate the nitro sulphobenzoic acid by fusion with potassium hydroxide yielded only a charred product from which nothing definite could be isolated. Such decompositions of nitro compounds during alkali fusion are known.¹¹

Full experimental details will be published elsewhere.

Organic Chem. Lab., M. RAGHAVAN.
Indian Institute of Sci., B. H. IYER.
Bangalore 3, P. C. GUHA.
February 14, 1949.

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DIELECTRIC CONSTANT OF IONIC SOLIDS

THE application of Debye Clausius Mosotti equation to the high dielectric constant of solids has been shown to be theoretically unsound and practically hopeless.

Even for alkali halides no theoretical calculation of the dielectric constant is possible, because of the difficulty in estimating the internal field in a crystal (cf. Mott and Gurney, 1940). One of us (S.K.K.J., 1944) has put forth a theory based upon the parallel and anti-parallel orientation ($2J+1=2$) in liquids and solids in a needle-shaped cavity, which yields an extraordinarily simple relationship(I) between the dielectric constant and dipole moment:

$$(\epsilon - n_{\infty}^2) \frac{M}{d} = 4\pi N u^2 / 3KT \left(\frac{J+1}{J} \right) \dots (I)$$

In the case of associated liquids like water, alcohols and ionic solids (rochelle salt, BaTiO₃) showing transition the characteristic temperature θ must be taken into account.

We have applied the above equation to the dielectric constants of alkali halides. The results are shown in Table I. The ionic character (*i*) as calculated by the ratio of the observed dipole to the full moment is found to be about 5% for all the alkali halides.

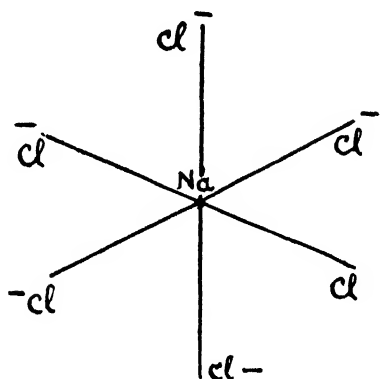
Dielectric Constant and Dipole Moments of Alkali Halides

	ϵ	n_{∞}^2	d	μ	i	$6A \times i$
NaCl ..	5.6 (1) 5.83 (4)	2.38	2.16	0.68 0.70	0.050 0.052	.52 .55
NaBr ..	6.1 (2) 6.39 (3)	3.08	3.20	0.72 0.75	0.049 0.052	.51 .55
KCl ..	4.5 (1) 4.8 (4)	2.22	1.97	0.67 0.71	0.045 0.047	.47 .49
KBr ..	4.6 (2) 4.7 (5)	2.43	2.75	0.70 0.72	0.045 0.046	.47 .48
RbCl ..	4.68 (1) 4.78 (4)	2.23	2.76	0.76 0.77	0.048 0.049	.50 .51
RbI ..	4.51 (4) 5.0 (7)	2.72	3.55	0.75 0.88	0.043 0.050	.45 .52

1. P. Schupp (1932); 2. Staulmann (1932); 3. S. Kyropoulos; 4. K. Højendahl (1933); 5. Heydweiller (1921); 6. Starke (1897); 7. Mott and Gurney (1940).

These results can be quantitatively explained on the basis of the concept of covalent-ionic resonance postulated by

Pauling without reference to his electronegativity theory. If we consider a six bonded unit NaCl_6 or ClNa_6



and that only one bond of the six, is covalent and the remaining fully ionic, the dipole moment due to four mutually perpendicular ionic bonds will cancel as they oppose in pairs

the remaining ClNa^+Cl^- will give 0.5 ionic character for a total of six NaCl bonds. If we assume that the influence of surrounding bonds is given by Madelung constant A just as in the case of bond energy, the effective ionic character for six NaCl bonds will be $6 \cdot A$ times the apparent ionic character of each bond. The results in the last column for a range of the alkali halides are in agreement with the theoretical value 0.5.

The above concept that only one bond out of six is covalent in character gives 5/6 or 83% as the value of the ionic character of alkali halides which is supported by the data on crystal energy, magneto optic anomaly, &c., as will be shown in a separate note.

Indian Inst. of Sci., S. K. K. JATKAR.
Bangalore 3, (Miss) S. B. KULKARNI.
February, 17, 1949.

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ON THE PREPARATION OF PALUDRINE (PROGUANIL)

FOLLOWING the discovery of Paludrine,¹ sufficient interest has been developed in the field of substituted biguanides as potential antimalarials. For the chemical synthesis of substituted biguanide derivatives, a number of methods¹⁻⁶ are available,

the simplest being the condensation of a substituted cyanoguanidine with an amine. For the synthesis of N^1 -aryl- N^5 -alkyl-biguanides the reaction between aryl-cyanoguanidine and alkylamine has been successfully conducted in the presence of copper sulphate or by fusion (using salt of the amine) but the desired products are not formed when the reactants are refluxed with alcohol.

During the course of investigations of N^1 -aryl- N^5 -heterocyclic biguanides,⁴ we were unable to condense certain substituted amino-heterocyclics (using hydrochloride salts) with arylcyanoguanidines in boiling alcohol. Considering that this reaction temperature may not be sufficient for reaction, iso-amyl alcohol was used instead in order to give reaction temperature of about 140°C . Although, no success was encountered in the above cases, the same procedure has been successfully employed for the preparation of paludrine as follows:

p -Chlorophenylecyanoguanidine (5 g.) and isopropylamine hydrochloride (3 g.) were refluxed together in isoamyl alcohol (15 c.c.) in an oil-bath maintained at 150°C . for 14 hours. The reaction mixture was extracted with boiling water and the aqueous portion was concentrated and chilled. Paludrine hydrochloride was collected by filtration and dried. Yield 1.5 g.; m.p. 244° .

Curd, *et al.*² have also recently prepared N^1 - p -fluorophenyl- N^5 -isopropyl-biguanide hydrochloride by a similar procedure, using nitrobenzene as solvent. In my experiment, replacement of iso-amyl-alcohol by nitrobenzene gave paludrine hydrochloride (3 g.), m.p. 244° .

Attempts are being made to improve the yield still further by varying the solvent and the experimental conditions.

My thanks are due to Prof. P. C. Guha and Dr. B. H. Iyer for their kind interest in this piece of work and also to the Indian Research Fund Association for the award of a Fellowship.

Organic Chem. Lab., H. L. BAMI,
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March 11, 1949.

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**THE DEVELOPMENT OF
HARPACTICOID COPEPOD,
MACROSETELLA GRACILIS (DANA.)**

THOUGH the typical Harpacticoid nauplii are said to be creepers on the bottom, the nauplii as well as the early copepodite stages of *M. gracilis* (Dana.) were found clinging to floating *Trichodysmium* strands, in the Plankton in September and October. The larvæ of this Copepod were grasping the algal strands considered inimical to living things by some, with the help of the well-developed antennæ or were actively crawling over these.

The eggs which are light yellow in colour and are carried in external brood-sacs, have a diameter varying from 0.06 m.m. to 0.08 m.m.

There are 6 naupliar stages as in all other Copepods. The nauplii are all coloured red owing to the presence of red pigment inside the body. The nauplius eye is present as a red-spot. The length of the nauplius at each of the six stages being 0.102 m.m., 0.130 m.m., 0.168 m.m., 0.205 m.m., 0.302 m.m. and 0.369 m.m., it will be obvious that the growth is uniform and that the increase from one stage to another is more or less mathematically constant obeying Brooks' law.

The progress of differentiation seen in the appendages through the six naupliar stages may be summarised briefly:—

Antennule: Rudimentary. Shows an increase in the number of joints at the 5th stage.
Antenna: well developed, 2-jointed, the 2nd joint being hinged to a claw. *Mandible*: single lobed with 2 curved setæ. A 3rd seta is added at the 4th stage. Posterior feeler continues to increase in size and complexity from the 1st stage when it is represented by a short bristle.

There are 6 Copepodite stages, the 6th being the adult itself. The number of segments in the body, the size of the body and the number of swimming feet present at different Copepodite stages are given in the table below:—

Stage	I	II	III	IV	V	VI
No. of joints in Metasome	3	3	3	4	4	5
No. of joints in Urosome	1	1	2	3	4	5 ♂ 4 ♀
Length in m.m.	0.484	0.616	0.742	0.922	1.24 ♀ 1.01 ♂	1.4 ♀ 1.1 ♂
No. of swimming feet	2	3	4	5	5	5

The increase in number and complexity of the appendages are briefly summarised thus:—
Antennule: Prominent, 5-jointed up to the 4th Copepodite stage. Geniculate and 7-jointed in the male and 8-jointed in the female from the 5th stage. *Antenna*: uniramous, 2-jointed in the 1st and 2nd Copepodites and 3-jointed from the 3rd stage onwards. *Mandible*: rudimentary. *1st Maxilla*: rudimentary. *2nd Maxilla*: indistinctly bilobed in the 1st and 2nd stages and 3-lobed from the 4th stage. *Marilliped*: well developed, 2-jointed, the 2nd joint being hinged to a claw.



PLATE I Nauplius 3rd stage under high power (40×10)

In the development of *Macrosetella*, the pronounced development of the antenna may be due to its prehensile function.

A full description of the developmental stages is given elsewhere.

The author thanks Dr. C. P. Gnanamuthu, M.A., D.Sc., F.Z.S., Director, University Zoology Laboratory, Madras, for his help and guidance.

University Zoology Lab., S. KRISHNASWAMY,
Chepauk, Madras,
November 8, 1948.

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**POST-EMBRYONIC DEVELOPMENT OF
ANTENNÆ IN APHIDS**

Introductory.—The antennæ in adult aphids are usually six jointed (except in a few forms like *Tetranura ulmifoliae* Baker) with two primary sensoria, one at the apex of seg. v,

and the other at the base of the flagellum. Number of sensoria on seg. iii, iv and v are variable in different species. In all the aphids however, the scape and the pedicel are the smallest of the segments.

For the post-embryonic development of antennae two species from each of the genera *Aphids* and *Macrosiphum* were under observation. The insects were bred in the laboratory on plants grown in pots of convenient size, covered over with lamp chimneys with the mouths capped with fine muslin. The observations on the antennal development were made on the offsprings from the same parents kept under identical conditions.

being sub-equal. The primary sensoria are shifted, one to the apex of seg. v and the other at the base of seg. vi.

Our observations are in conformity with those of Bhargava (1947) that the pedicel does not divide in *Aphididae*. Sexena (1946) however, remarks that an increase in the antennal segments is brought about by the division of the pedicel. This, however, does not hold good in *Aphididae* where the seg. iii divides by two successive divisions and thus ultimately the antenna becomes 6 segmented.

Genus Macrosiphum.—The antennae in the 1st instar nymph is 5 segmented, segments i and ii being sub-equal and the last being the

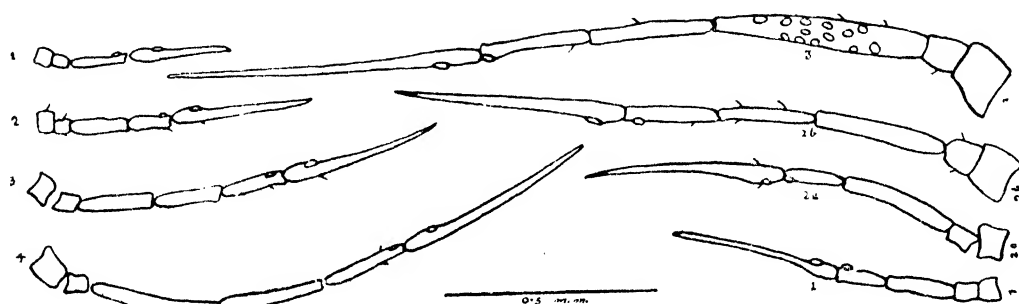


PLATE I. Antennal Development in Aphids

Genus Aphis.—On the first day of hatching the antenna is only 4 segmented, the scape and pedicel are sub-equal, the last segment the longest. Primary sensoria are present, one at the apex of seg. iii, and the other near the major constriction of the flagellum. Just before the first moult, seg. iii shows a little constriction. In the second instar the antenna continues to grow showing a clear demarcation within the seg. iii. Thus the antenna is now 5 segmented, the primary sensoria previously on seg. iii is now shifted at the apex of seg. iv, and the other as usual, placed at the base of the flagellum. The flagellum in the second instar is relatively longer than in the first instar. Similarly, seg. iii has grown longer than in the previous instar. In the beginning of the third instar there are still 5 antennal segments, seg. i and ii being equal, iii longer than iv and the flagellum of the terminal segment being the longest. The primary sensoria are situated on the apex of seg. iv and the other at the base of seg. v. Prior to the next moulting however, a constriction again appears in seg. iii, thus making in all 6 segments. During the 4th instar, segments iii, iv, v and vi continue to elongate, the first two segments

longest. Primary sensoria are located, one at the apex of seg. iv, and the other compound sensorium at the major constriction of the flagellum. In the beginning of the second instar seg. ii is slightly longer than seg. i, segments iii and iv continue to elongate, and the flagellum is the longest. Seg. iii becomes uniformly thick, and a slight constriction appears. The primary sensoria are situated, one at the apex of seg. v (original iv) and the other at the base of the flagellum. Prior to second moulting, segmentation in seg. iii becomes more marked and the antenna becomes 6 segmented. During the third instar all the individual segments continue to grow, seg. iv and v are sub-equal, seg. iii longer than iv, and flagellum again the longest. The position of primary sensoria is the same as in the previous instar. In the 4th instar, seg. iii attains normal length and is longer than seg. iv or v. The individual segments continue to grow to attain their normal lengths.

Obviously the segment iii divides but only once in this case.

Summary.—Unlike in the genus *Aphis* there are 5 segments in the antenna of freshly born *Macrosiphum* nymph. The cleavage in seg. iii

is seen just in the beginning of the second instar, yet only 5 antennal segments are made out. However, the segmentation at the end of the same instar is completed and thus 6 segments are made out. The lengths of antennal segments after the division and just in the beginning of third instar are given below. The individual segments continue to grow in different instars until normal proportionate lengths are attained in their adult stage. Thus, in the third instar the number of antennal segments in *Macrosiphum* nymphs are six.

TABLE I
Measurements of antennal segments in
Aphids during different instars

Instars	Antennal segments	APHIDS				Remarks
		<i>Aphis fabae</i>	<i>Aphis</i> spp.	<i>Macrosiphum fabae</i>	<i>Macrosiphum persi</i>	
		Average measurements in m.m.				
I	i	0.03	0.03	0.04	0.04	In each case averages are derived from antennal measurements of 6 nymphs bred under observation
	ii	0.04	0.03	0.04	0.04	
	iii	0.16	0.15	0.16	0.22	
	iv	0.26	0.23	0.12	0.22	
	v	..	..	0.41	0.57
	vi	..	..	..	..
II	i	0.04	0.04	0.04	0.06	<i>Aphis</i> : seg. iii shows clear division, splitting it into two.
	ii	0.04	0.04	0.06	0.08	
	iii	0.13	0.15	0.27	0.34	<i>Macrosiphum</i> : seg. iii uniformly swollen and a slight cleavage could be noticed.
	iv	0.08	0.09	0.15	0.28	
	v	0.32	0.32	0.49	0.69	
	vi	..	..	..	..
III	i	0.04	0.04	0.09	0.08	<i>Aphis</i> : Seg. iii shows thickening at base, cleavage is seen in seg. iii, seg. v
	ii	0.04	0.04	0.08	0.09	
	iii	0.13	0.18	0.28	0.33	now becomes vi. In <i>Macrosiph</i> as well the full compliment of six segments is observed in this instar.
	iv	0.08	0.16	0.22	0.36	
	v	0.09	0.15	0.22	0.35	
	vi	0.37	0.41	0.57	0.91	
IV	i	0.09	0.06	0.09	0.13	
	ii	0.08	0.06	0.09	0.08	
	iii	0.36	0.29	0.53	1.13	
	iv	0.33	0.22	0.28	0.78	
	v	0.25	0.22	0.28	0.71	
	vi	0.58	0.50	0.77	1.35	

The difference between antennal developments in the two different genera, namely *Aphis* and *Macrosiphum*, were not noticed by Bhargava (1947).

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College of Agriculture, H. L. KULKARNY.
Poona 5,
November 19, 1948.

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DIMORPHISM IN STAMENS OF *CROTOLARIA JUNCEA*

In the course of our studies on anthesis of crop plants, an interesting type of dimorphism in stamens was observed in *Crotolaria juncea*.

The inflorescence is a raceme with the number of flowers ranging from 14 to 22 with an average of 16. The number of days taken from the bud initiation to flower opening is on an average 20. The flower remains open for a day. The flower is typically papilionaceous, the only interesting feature being the dimorphic stamens. The androecium consists of 10 stamens, 5 of which have round anthers and 5 linear anthers, arranged alternately on a ring.

TABLE I
Lengths of the dimorphic stamens during
the development of the flower-bud in
Crotolaria juncea

Developmental stages of flower-bud	Age in days	Length in cm. of the stamens with linear anthers	* Length in cm. of the stamens with round anther	Difference in length of stamens of the two types	Remarks
1	5	0.40	0.05	-0.35	Equal growth
2	6	0.50	0.05	-0.45	
3	7	0.55	0.10	-0.45	
4	8	0.52	0.10	-0.45	
5	9	0.60	0.15	-0.45	
6	10	0.65	0.15	-0.50	
7	11	—	—	—	Growth rapid in stamens with linear anthers
8	12	0.80	0.14	-0.66	
9	13	0.80	0.20	-0.60	Equal growth rate
10	14	0.87	0.30	-0.57	
11	15	0.95	0.30	-0.55	Growth more rapid in stamens with round anthers
12	16	1.20	0.60	-0.60	
13	17	1.30	0.80	-0.50	
14	18	1.25	1.00	-0.25	
15	19	1.20	1.30	+0.10	
16	20	1.30	1.50	+0.20	
(Open flower)					

* The length is measured from the base of the staminal ring to the tip of the anthers. Each figure is an average of five observations.

During the growth of the bud, there is a differential growth of the filaments of the dimorphic stamens. At each of the sixteen stages of the development of the flower bud, the staminal bundle was dissected out of the flower and the length of the two types of stamens was measured. The growth in length of the two types of stamens at different stages of the development of the bud is given in the above table.

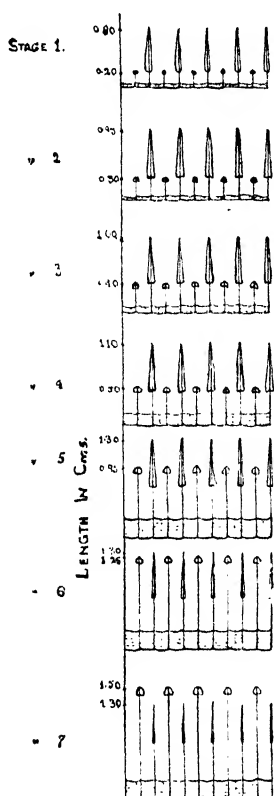


FIG. 1. Growth in length of the dimorphic stamens of *Crotolaria juncea* during flower bud development.

Fig. 1 represents the dimorphic stamens drawn to scale from seven representative stages in anthesis.

The measurements could be started only when the buds were 5 days old. At the first stage stamens with the linear anthers are 0.5 cm. in length while those with round anthers are 0.05 cm., the difference being 0.45 cm. Till the buds are 10 days old, the rate of growth of both types of stamens is the same as indicated by the constant difference of 0.45 cm. between the

lengths of the two. Between the 10th and the 12th day, the stamens with the linear anthers grow more rapidly, the difference between the two now being 0.66 cm. Between the 12th and 16th day the rate of growth in the two types of stamens is again equal as indicated by a constant difference between the two (Table I). Between the 16th and 20th day, there is a reversal in the growth rate of the two types of stamens—those with round anthers elongate very rapidly at the rate of 0.2 to 0.3 cm. per day while those with linear anthers do not increase in length at all (Table I). In the fully opened flower the stamens with round anthers are 0.2 cm. longer than those with the linear anthers (Table I, Fig. 1).

While the period of elongation of the stamens with linear anthers is up to the 16th day, that of the round anther bearing stamens extends over the whole period. The period of maximum elongation of the stamens with linear anthers is from the 10th to the 12th day while that of the other type is between the 16th and 20th day.

The linear anthers dehisce at the 12th stage while round anthers dehisce at the 16th stage

Howard, Howard and Khan¹ studied pollination in this plant and observed that cross-pollination takes place and that self-pollination is possible if the stigmatic surface is stimulated by insects or other means. Samal and Benerji² while studying the microsporogenesis in this plant have recorded dimorphism of stamens with respect to anther shape only. Our detailed study of anthesis has indicated that this dimorphism extends to the relative growth in the two types of stamens at different stages of development.

The bearing of this dimorphism in stamens on the pollination in this plant is being investigated.

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Balwant Rajput College,
Agra,

December 1, 1948.

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FEEDING METHODS OF THE COTTON WHITE-FLY

STUDIES on virus transmission by the white-fly (*Bemisia tabaci* Genn.) have shown that the insect is a vector of several virus diseases of plants prevailing in this Province. Some of these diseases are of the 'localised' type, such as the yellow vein-mosaic of bhendi,¹ while others are 'non-localised' like the yellow mosaic of *Phaseolus lunatus*.² Moreover, the white-fly requires much longer Feeding Time in order to secure virus from diseased plant than for transmitting it to a healthy one irrespective of the type of virus involved.³ These and similar other observations necessitated detailed investigation on the feeding methods of the adult white-fly in relation to the viruses it transmits. This note briefly deals with the preliminaries.

Hargreaves⁴ and Smith⁵ observed that the *Aleyrodes* larvæ feed mostly on the phloem, although stylets were observed to be present in the paranchyma alone, specially in the case of very young larvæ.⁵ However, no information is available in literature as to the methods by which the adult white-fly penetrates and taps the host tissues for extracting food.

In order to fix the flies in their feeding position it was necessary to starve them for at least three hours before liberating them on the host plants. The host plants used were *Hibiscus esculentus* L., *Phaseolus lunatus* L., *P. vulgaris* L., and *Dolichos lablab* L. Insects were confined to individual leaves of the host plants and allowed varying Feeding Time, after which they were killed *in situ* with the help of a wad of cottonwool soaked in chloroform. Thereafter, the portion of the leaf with the insects on was cut into pieces of convenient size and fixed in formalin acetic acid alcohol fixative, sectioned 10- to 15-micron thick by the usual paraffin method,⁶ and stained either with Heidenhain's hæmatoxylin or Flemming's triple stains.

The fly as a habit settles down to feed on the underside of leaf and punctures the lower epidermis at any place (Figs. 1 and 2), but before doing so it deposits some salivary secretions on the spot to be pierced and also applies pressure on it with its rostrum in order perhaps to stretch the layer (Fig. 1). The stylets enter the leaf usually between two cells and take an intercellular course in the mesophyll (Figs. 1 and 2),

while an intracellular course in collenchyma and in the phloem tissues. During the progress of the stylets into leaf tissues, the fly deposits along with its saliva a substance which sets into a hard gel forming a tubular sheath (Figs. 1 and 2).



FIG. 1. T.S. of leaf of *Hibiscus esculentus* with a salivary sheath, indicating the intercellular course of the stylet track in the mesophyll. Note depression and salivary deposits outside on the epidermis.

These sheaths stain deep red with Fleming's triple or deep blue with hæmatoxylin and form well marked stylet tracks in the leaf.

The ultimate objective of the flies is the phloem (Fig. 2) from which they suck their food. When the flies were allowed to feed for 15 or 30 minutes only, most of the salivary sheaths were found to be short and terminating abruptly in the mesophyll, occasionally going even as far as the palisade layer (Fig. 1). When, however, the insects were allowed longer Feeding Time, the salivary sheaths were long and curved or profusely branched, and in majority of the cases the stylets reached the phloem. Also, more than one salivary sheaths were present close to each other indicating that the insect withdraws completely from the leaf after having fed on a particular cell and punctures again in the near vicinity, following almost the same course, in order perhaps to tap another

sieve tube or cell. Since no visible injury in caused to the host plants by the feeding of white-flies, it is evident that the insect saliva is non-toxic to plant tissues.



FIG. 2. T. S. of leaf of *Phaseolus lunatus* showing the stylets and the stylet track. The position of the salivary sheath in leaf indicates that the insect had been feeding upon the phloem.

This work is being carried out under a scheme financed by the Indian Council of Agricultural Research.

Plant Path. Laboratory, S. P. CAPOOR.
College of Agriculture,
Poona 5,
December 6, 1948.

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PRODUCTION OF OOSPORES BY *SCLEROSPORA SORGHII* ON MAIZE

WITH the exception of *Sclerospora macrospora* Sacc., no other definite species of *Sclerospora* with the non-sexual stage bearing conidia or sporangia on tree-like conidiophores, has so far been reported to form the oosporic stage on maize (*Zea mays* L.). In February 1940, the writer observed some maize plants, variety Kashmir Sweet, which were quite stunted and etiolated. An examination of the leaves indicated that

the plants had been attacked by a species of *Sclerospora*. Other varieties of maize, even though they were affected by the same disease, did not show the formation of oospores.

Comparative studies of conidia, oospores, etc., have indicated that this *Sclerospora* is identical, with regard to shape and size, with *Sclerospora sorghi* (Kulkarni) Weston and Uppal. Cross-inoculation tests have further shown that *Sclerospora sorghi* from Jowar (*Sorghum vulgare*) can infect the Kashmir Sweet variety of maize and *vice versa*.

As the position of *Sclerospora macrospora* whose non-sexual stage does not involve tree-like conidiophores but unusual single, large Phytophthora-like sporangia borne singly on stalk, in the genus *Sclerospora* is doubtful, this perhaps is the first report of the discovery of the oosporic stage on maize.

A detailed report will soon be published.
Plant Path. Laboratory,
College of Agriculture,
Poona,
January 15, 1949.

M. K. PATEL.

DOLICHOS BIFLORUS L.—A NEW HOST OF *XANTHOMONAS PHASEOLI* SOJENSE (HEDGES) DOWSON

SOYBEAN cultivation in this Province is at present of minor importance. On the other hand, *Kulthi* (*D. biflorus*) is cultivated quite commonly as a pulse and fodder crop either mixed with Jowar and Bajri or alone on light soils during the kharif season. A bacterial leaf-spot on *kulthi* was found on the Government Farm, Nipani in Belgaum district in August 1948. The disease resembled that on soybean so much so that the pathogene was isolated and studied in detail.

On the *kulthi* leaves, the pathogene produces numerous minute specks which coalesce forming lesions which measure 1 to 2 mm. The spots are raised, rough to touch mainly due to dried bacterial exudations and are found on both sides of the leaves with a light brown border around such spots. The pathogene was found to infect leaf-petioles also. The bacterium isolated from *kulthi* leaves was sprayed on 2 varieties of this host, *viz.*, one with black seeds from Nipani and the other from Poona with brown seeds. The black-seeded Nipani variety looked very much like the soybean

plants in its seedling stage that it was considered advisable to inoculate soybean plants with the *kulthi* culture. Both the hosts showed characteristic symptoms of the disease in 10 days. *X. phaseoli sojense* was then sprayed on the leaves of soybean and *kulthi* when it was found to produce the characteristic symptoms.

Since the *kulthi* organism resembles *X. phaseoli sojense* in morphological, cultural and physiological characters and since both these pathogens are cross-inoculable, it is considered that *D. biflorus* is a new host of *X. phaseoli sojense* hitherto unreported.

Plant Path. Laboratory, M. K. PATEL.
College of Agriculture, Y. S. KULKARNI.
Poona, G. W. DHANDE.
January 15, 1949.

A REMARKABLE ABNORMALITY IN THE DEVELOPMENT OF *VIVIPARUS* *DISSIMILIS* (MULLER)

DRUMMOND¹ observed a few abnormalities in the development of *Paludina* (= *Viviparus*), and Mattox² has described the abnormalities in the intra-uterine young ones of *Campeloma*. Apart from these observa-

malities in *Viviparus dissimilis*, which is represented in the accompanying illustrations. The embryo, which was living and actively swimming in the albumen in the egg, belongs to an advanced stage of development. The head and foot are normal. The tentacles, the eyes, the buccal mass, the radula, the salivary glands, the opercular area of the foot and the ctenidium have all attained the definitive organization. But the visceral hump is very peculiar. It has bulged posteriorly and dorsally, and is roughly thimble-shaped with a ventral flexure, but without spiral coiling or lateral torsion. The neck of tissue between the visceral mass and the rest of the body is much elongated as compared with the normal condition, and not twisted. Other noteworthy features relating to the abnormality of the visceral mass are the complete absence of a shell and the non-differentiation of the digestive gland.

But the most striking features relate to the mantle cavity, and especially the ctenidium. The mantle cavity is but little developed, being in the form of shallow and open cavity without a roof, and situated at the hind end of the embryo. It is better developed on the left side. The

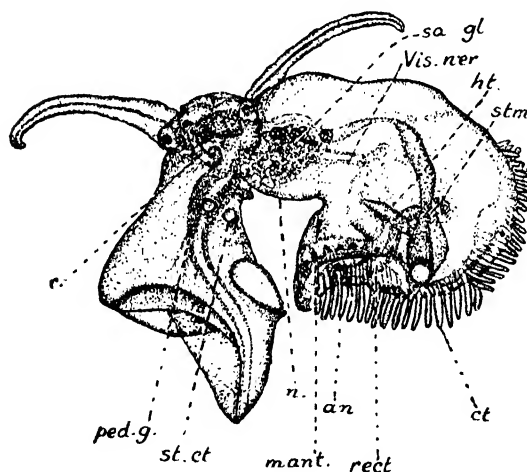


FIG. 1. Abnormal embryo of *Viviparus dissimilis*, viewed from the left side

an., anus; ct., ctenidium; gon., gonadial rudiment; ht., heart; mant. mar., mantle margin; n., neck; ped. g., pedal ganglion; per., pericardium; r., radular sac; rect., rectum; sa. gl., salivary gland; stm., stomach; st. ct., statocyst; visc. ner., visceral nerve.

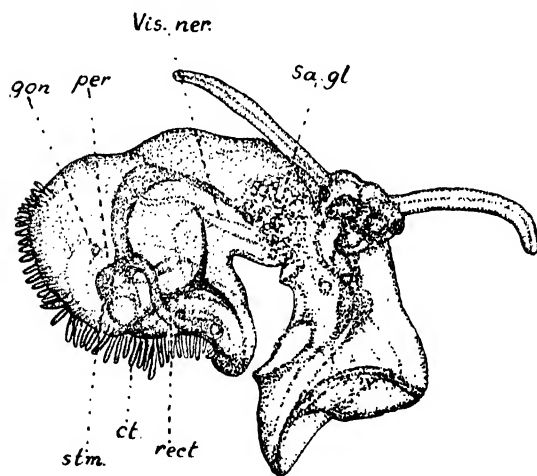


FIG. 2. Abnormal embryo of *Viviparus dissimilis*, viewed from the right side

ctenidium however is well developed, much elongated and composed of about forty filaments. But its position is abnormal, as

it extends on the outer surface of the visceral hump from the rudimentary mantle-edge right up to the apex. Alongside of the ctenidium is a low ridge which probably represents the aborted continuation of the mantle fold. The position of the ctenidium in relation to the rectum is also noteworthy, since it is found to the left of the rectum and would have become the topographically right ctenidium if torsion had taken place and the mantle cavity shifted to the anterior end, whereas in the typical streptoneurous Gastropod the definitive ctenidium is the primitive right but topographically left ctenidium. The other pallial organs also have consequently changed their position in relation to the rectum in the present case, which may be considered therefore as an instance of *situs inversus*.

The posterior position of the mantle cavity admits of an explanation in terms of differential growth, but the position of the ctenidium on the outer side of the visceral hump is very puzzling. There is no evidence of the mantle having turned inside out (by a process analogous to that of an extrogastrula). Probably the ctenidial rudiment has developed precociously and grown rapidly along with the visceral hump, while the mantle fold has remained in an abortive condition, spread out and continued as a low ridge alongside of the ctenidium, so that the mantle cavity is shallow and without a roof.

It may not be incorrect to attribute the abnormalities partly to the non-development of the shell gland, for the development of the mantle fold and mantle groove is related in space and time to that of the shell gland. But to account for the suppression of the shell gland is not easy. I have been trying to induce experimentally this type of abnormality in the laboratory, but have not been successful so far. If we could understand the causal factors of abnormal development, some of the problems of Gastropod development like torsion would be better explained than at present.

Zoology Laboratory, R. V. SESHAIYA.
Annamalai University,
Annamalainagar,
February 4, 1949.

CARPET BEETLE DAMAGE TO TELEPHONE WIRES

THE carpet beetle (*Anthrenus* sp., *Dermestidae*, *Coleoptera*), is commonly met with in different parts of India, damaging woollen fabrics. On account of the large tufts of hair on the grubs and pupæ, the insect is popularly called the 'woolly bear'. The damage is caused mostly by the grub, which bites the woven fabric causing holes and ultimately converting the same into a mass of cut threads.

The insect shuns light and invariably feeds on that surface of the fabric which is against light and thus avoids easy detection.

In February 1948, the Telephone Exchange, Bangalore, reported serious damage to the insulation of the telephone wires of the machinery. On examination large numbers of this insect in various stages of development were found infesting the material; the insect was probably breeding in the medium for some time prior to February. Availability of plenty of food material and the well-closed rooms were very well suited for the optimum activity and rapid multiplication.

Thousands of grubs had scraped and bitten the insulation material, exposing the wire and harboured themselves in the several crevices thus created. As a consequence, it was reported that there was short circuit.

A dust containing a mixture of 4 parts of D.D.T. spray powder (Geigy), 4 parts of Pyrethrum and 1 part of Gammexane D 025 (I.C.I.) was used against the insect. The worst affected columns of machinery were completely covered with tarpaulin and then the dust applied liberally. About 2 hours after dusting most of the grubs and adults were found to be disturbed from their resting places and few were found in a moribund condition. As a small number of grubs were found alive even after 96 hours it was found necessary to give a second dusting. Sufficient time was allowed for the egg, if any, to hatch out and a second dusting was done allowing an interval of three weeks between the two dustings.

I am grateful to Sri. B. Krishnamurti, Government Entomologist, for advice.
Entomological Lab., M. APPANNA.
Agri. College and Res. Inst.,
Bangalore,
March 7, 1949.

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REVIEWS

Waste Heat Recovery from Industrial Furnaces. A Symposium. (Published by Chapman & Hall Ltd., London). 1948. Pp. x+383. Price 35sh. nett.

This is an important publication of great practical value. The contributors to this Symposium conducted by the Institute of Fuel, London, are eminent authorities in different branches of the subject handled by them. The chief aim of everyone of the authors has been the application of available scientific data in a most practical manner to introduce the latest methods of waste heat recovery and derive financial benefit.

The Institute of Fuel is one of the most important technical organisations in England and national in its outlook. The present publication is educative and propagandistic in the methods of its approach and appeal. It is mainly addressed to British industrialists. Mr. G. N. Critchley says: "It therefore becomes a matter of great importance to study the means whereby the limited amount of fuel available may be made to produce the greatest output of goods, not only for home requirements but also to supply export markets on a far greater scale than ever before." The manner and method of achieving this, are elaborated by the contributors in a most scientific and practical manner in the body of the book. All those who are engaged in industries that use large quantities of coal or gas should feel grateful to the authors.

It is necessary to keep in mind that this publication confines itself only to the subject of the recovery of heat from waste gases from industrial furnaces,—nothing more or nothing less. It does not deal with the whole subject of fuel economy which forms the subject of matter of a masterly treatise entitled "Efficient use of Fuel" published three or four years ago by H.M.G. Stationery Office, London. As a matter of fact a general study of this treatise as well as a study of the book entitled "Industrial Furnaces" published by Messrs. John Wiley and Sons will form a helpful and useful background for fully appreciating the recovery of waste heat from industrial furnaces.

According to the temperature required in industrial heating operations, the flue gases must leave at a more or less elevated temperature which will obviously be above the temperature to which materials are heated in the

furnace. Part of the sensible heat of these gases will be required to create the necessary draught if a chimney is used for this purpose. If a fan is used for creating the draught the outlet temperature can be very much lower. The gap (or difference) between the outlet temperature of the furnace and the minimum permissible temperature of discharge represents heat which could be saved. This, in essence, is what is popularly known as waste heat recovery from industrial furnaces.

For purposes of waste heat recovery, recuperators or regenerators are in use. Recuperators consist broadly of systems of flues, some of which carry in-going air, and others outgoing flue gases at a higher temperature, so arranged that there can be heat interchange between the air and gas. On the other hand, a regenerator is simply a heat exchanger constructed of refractory material. In its simplest form it comprises two chambers filled with chequer firebricks, the bricks being so stacked that gases can flow freely between them and around them. The waste heat from industrial furnaces has in very many instances been utilised for the raising of steam in specially designed waste heat boilers.

The first two chapters of the book under review furnish all the scientific data on the theoretical side of the problem. Then follows special experiments conducted on pilot plant scale on the engineering side of the problem to determine the factors governing the design of regenerators (with special reference to coke ovens) and tubular metallic recuperators and waste heat boilers. The remaining chapters have the problems of special industries like carbonising industries, metallurgical industries and the glass container industry considered in great detail with a view to introduce economies in working by the recovery of waste heat. Closely connected with waste heat recovery are problems of refractories and insulations. Adequate treatment has been given to these two subjects. The savings that can be effected in the annual consumption of coal and the labour employed and the consequential cash gain by adoption of waste heat recovery methods in a scientific manner by some extra capital equipments have been analysed and the results given in Tables I and II. These two tables merit very close study and will convince any industrialist about the wisdom of installing waste heat recovery equipment as soon as possible.

Taking into consideration such an ordinary and routine thing as proper insulation, it is amazing to read in Tables I & II that by proper insulation applied to the roof of a glass melting furnace at a cost of £210 and on the basis of working the furnace for 8,000 hours in a year, 940 tons of coal can be saved per annum which would cost £1,880. If the insulation would last for five years, the annual return on the investment would amount to 895% and during the five-year period of the insulation's life, the total return on the capital invested would be 4,475%! This is not all. The labour required to mine 940 tons of coal per annum or 4,720 tons during the five year period of insulation's life is a national gain, since this labour can be employed to produce more coal or be employed in other gainful occupations.

The book is recommended for study by every student of fuel technology. It more than repays the time required for it. The price of the book is somewhat on higher side.

So far as conditions obtain in India, the biggest users of coal for industrial purposes happen to be the Tata Iron & Steel Co., and the Indian Iron & Steel Co. Reports indicate that they both seem to be alive to this problem and a lot has been done in this direction. They seem to be up-to-date on this subject but still, —one never knows—a study of this book may reveal places where the waste heat recovery has been neglected and may be adopted in future. So far as the cement industry in India is concerned, it is a matter of regret that the industry as a whole has not looked into this problem at all. It is a great pity. One hopes that just as the British Government did during the war time and subsequently, our own Government would carry on propaganda to educate the sponsors of the cement industry about the waste heat recovery problems. So far as the glass industry is concerned, enterprising firms like Messrs. Ogale Glass Works, seem to be alive to this problem and they have recuperative or regenerative devices in connection with their tank furnaces. The methods employed in the glass bangle industry, since they are produced on a comparatively small scale, do not seem to admit of these modern methods of heat recovery but it is hoped that the new Institute of Glass Technology started as one of the National institutions will devote its closest attention to design improved furnaces even for the bangle industry to save fuel. In connection with the contact sulphuric acid manufacture at Tata Iron and Steel Works and also at Belagula at the Mysore Chemicals & Ferti-

lisers Factory, waste heat boilers have been employed. There have been some sporadic attempts at the Mysore Iron & Steel Works to use the flue gases from wood carbonisation retorts to pre-dry the incoming wood. On the whole, Indian industrialists do not seem to have been seized of the importance of this problem and the sooner they did the better it will be. The new All-India Institute of Fuel Technology that will be started at Dhanbad will have to undertake this work in a systematic manner and introduce all the latest methods of waste heat recovery by insisting on this, by legislation if necessary.

The importance of this problem to a country like England can be gathered by a quotation from the Foreword to the book by Mr. E. W. Smith. "It has been authoritatively stated that not more than 15–20% of the energy of our coal supplies is usefully employed... Even an additional 5% improvement would mean the savings in coal mined of between fifty to seventy million tons a year....!" The entire output of coal in India, roughly about thirty million tons a year, is only half of what Mr. E. W. Smith hopes to gain by introducing rational methods of waste heat recovery in England! Therefore, all those in India concerned with the future of industrial development should wake up and lose no time in tackling the problem in India in the most up-to-date manner.

Without in any way trying to detract from the exceptional merits of the publication, the reviewer may be permitted to notice the very first sentence by Mr. G. N. Critchley in his introduction to the book: "At the present time (June 1946) it appears likely that for at least some years ahead supplies of coal mined in Great Britain will be insufficient to meet full industrial requirements. There is thus a probability that fuel will, unless it proves economically practicable to import large quantities from abroad, be a major factor restricting national prosperity." It almost looks humorous that England, even as a distant possibility, thinks of importing coal from abroad. England has always prided herself on her coal deposits and time and again prominent people have made public statements, with a sense of pride to which they are entitled to. One prominent man stated:—"Civilisation is economy of power and our natural power is coal". Another leader stated: "It is cheapness and abundance of coal which has made us (British Empire) what we are." In fact, Great Britain has been one of the chief

countries for exporting coal in exchange for raw materials and foodstuff. Even now, the present Labour Government is fully determined to maintain the export of coal to other countries of the World and to afford bunkering facilities to steamships. And England is not likely to lightly change this attitude. The question then arises, "Why should England envisage a time when she may have to import coal from abroad?" It can only mean that she would like to have a tight hold on her export markets in order to maintain her national economy in other directions and if and when necessary also to import coal from other countries. In connection with the Organisation for European Economic Co-operation (O.E.E.C.), two white papers have been presented to the Parliament by Sir Stafford Cripps recently. It is mentioned therein that the coal exports which have been always a great asset in the Nation's economy have now assumed even greater importance as they can directly reduce the dollar expenditure of other European countries. With this thing in view, Sir Stafford Cripps suggests a target of 40 million tons for exports and bunkers from a total output (including open-cast) of between 250 to 260 million tons of coal mined in England. It only means that she does not want to lose even a single market. If necessary, she may import coal for her own needs and export her own coal abroad and thus continue her dominant position in a field in which she has been all too powerful all these years. There is nothing wrong in this and we wish them well.

Finally it is to be hoped that the Institute of Fuel, London, will publish other studies in the economy and use of fuel as soon as possible. Our thanks are due to this Institute for giving the world public this valuable publication.

S. G. SASTRY.

British Chemical Nomenclature. A. D. Mitchell. (Edward Arnold & Co.), 1948. Pp. 156+iv. Price 21/- net.

It is sad to contemplate that chemistry still lacks what Foster in the middle of the last century described as "the legal language of the science—a language whose terms are, as far as possible, strictly defined and have an exact and generally recognised value". Several attempts to standardise chemical nomenclature through international conferences have borne fruit only to a limited extent, partly because of the desire on the part of the national societies not to deviate from their established usage, and partly because of the

failure of these conferences, meeting at rear intervals, to keep pace with the rapid advances made in the meantime. In the absence of a universal system of nomenclature, the various publishing societies have adopted the only possible alternative, viz., that of framing a set of rules for their own guidance. Thus have arisen three main systems, viz., the British, the American and the Continental or German systems, each with its own established rules of nomenclature and enumeration which are often quite arbitrary and in many instances entirely different from those of the other two. No systematic attempt appears so far to have been made to present any of these systems in a consolidated form, although it must be admitted that the problem has been studied comparatively more fully in America than elsewhere, the compilation of the Ring Index by the American Chemical Society being justly regarded as a most valuable contribution.

The present volume embodying the conventions adopted in the *Journal of the Chemical Society* is therefore to be welcomed. The lucid lecture on British Chemical Nomenclature delivered by the late Dr. Clarence Smith in 1936 has been the only authoritative account recorded so far of this system, but the subsequent additions and amendments to the principles enunciated in it have often been hidden away in the footnotes of the *Journal*. With over twenty years of association with the *Journal*, the author of the book under review is eminently fitted to accomplish the task which he has set out to perform, viz., to prescribe general principles and their application to a variety of individual cases. The very nature of the contents of the book which are, in the main, a collection of rules of nomenclature and enumeration of both inorganic and organic compounds, prevents their detailed examination here. The journals in India tend to allow a good deal of freedom to authors in the choice of the system of nomenclature, but it is desirable that at least each journal adheres strictly to one definite system of nomenclature. Chemists using the British system will find this monograph to be of great service. The author has rightly drawn the attention of his readers, wherever necessary, to the gaps and inconsistencies in the present usage. The flexibility of the rules and the freedom that is often allowed to individual authors naturally result in inconsistencies which reach bewildering proportions in the case of complex fused ring systems.

On the need for a radical reform of the existing systems and for the adoption of a

universal system there can be no two opinions. But "national bodies never seem to realise that if any uniformity is ever to be attained and chaos avoided, concessions must be made." The new system of notation and enumeration of organic compounds proposed by G. M. Dyson in his book ("A New Notation & Enumeration System for Organic Compounds", Longmans, Green & Co., 1946) with its simple and invariant set of rules resulting in unique linear ciphers for the compounds which could be handled mechanically by a system of punched cards for the purposes of indexing, literature survey, etc., has much to recommend itself for universal adoption. But, in spite of the general desire to do away with trivial names in chemical literature, it is doubtful if even this system can succeed in doing so, since the ciphers share with the graphical formulæ one of the inherent drawbacks of the latter, viz., the lack of a facile speech equivalent.

The get-up of the book is excellent and the index is comprehensive.

B. B. DEX.

Research in Industry. (Published for D.S.I.R. and the Board of Trade by His Majesty's Stationery Office, London. Price 1sh. 6d.)

The articles published in the volume cover a variety of industries, i.e., cotton, wool, rayon, glass, pottery, iron and steel, lace, linen, boots and shoes, paint, furniture, plastics, light engineering and electrical consumer goods. In addition there are articles on electronics, machine tools, industrial design and radar.

The emphasis in each case is laid on the value of research for the future, both immediate and more distant, but examples of what research has already done for the industry are also given.

The article on wool for instance, describes research work done on carding which proved that lines of development employing higher speeds and fewer parts were practicable, contrary to previous accepted opinion. It was then possible to specify an 'ideal' card and to demonstrate this to firms and their carding engineers. With this machine a great increase in production can be obtained. Further, it was possible to achieve most of the advantages of the 'ideal' card by modifying the existing cards, without waiting for new ones.

A more spectacular example of the impact of science on industry has been the steady replacement in the potteries of the old type of coal-fired bottle oven by the modern tunnel oven. The advantages of this are that the

labour involved in firing ware is reduced, the work is made more pleasant, the firing cost is lowered, the quality of the actual ware is improved, and the thermal efficiency of the oven is increased. The kilns are fired by smokeless fuel, which will decrease the heavy pall of smoke which, up to now, has been an unpleasant feature of the pottery areas.

The article on electronics gives some details of what these devices are able to do for manufacturers. They can control machine tools, detect internal flaws and faults in metals, match colours, count and inspect finished products for size, surface finish, and weight. Almost any property of a product can be measured. There is wide scope for these devices in the protection worked from guillotines, presses, millers and so on. The application of the electronics to industry is practically limitless.

One of the industries which might be described as the child of research is plastics. Some of the uses of the 'silicones' are described in the article by Mr. N. J. L. Megson. In the baking industry, for example, silicones can replace fat for greasing baking tins. One application of silicone resin permits the baking of very many batches of loaves, whereas with fat the tins have to be greased after every batch. Only ten years ago silicones were regarded as laboratory curiosities having no commercial possibilities!

The potentialities of research applied to industry are well illustrated in the section on machine tools. Investigations carried out recently on drilling showed that the overall economic efficiency can be greatly increased by applying the results obtained. Moreover, these investigations and others showed that a few hundred pounds spent on this type of small tool research will save or yield as many thousands of pounds each year in a single factory if properly applied.

The necessity of following up research results at once is stressed in a foreword by Sir E. Appleton. As an example, he mentions the publication of a report on the fire proofing of fabrics for which the Stationery Office received a considerable number of orders from the U.S.A. within a few days of publication.

Organic Reactions: Vol. IV. Edited by Roger Adams. (Wiley & Sons, Inc., New York; Chapman & Hall, London), 1948. Pp. 428. Price \$ 6.00.

The fourth volume of the series of extremely valuable reviews of important synthetic organic

chemical reactions maintains the high standard of the first volume which appeared in 1942. As in the previous volumes each chapter is written by a specialist and provides a comprehensive survey of a reaction, which includes a general discussion of its nature and mechanism, its scope and limitations, and a detailed description of experimental procedure for the synthesis of typical compounds by the use of the reaction. Tables of the various compounds synthesised by or subjected to the reaction under review, pertinent experimental conditions including the yields obtained, and numerous references to the literature are, as in the earlier volumes, notable features of the book.

The Diels-Alder reaction, discussed in Chapters 1 and 2, is of outstanding importance on account of its versatility and the light it has thrown on the mechanism of polymerisation. The various types of compounds which can serve as dienes and as dienophiles are tabulated and the vast literature on the constitution of the adducts with maleic anhydride (in Chapter 1) and with ethylenic and acetylenic compounds (in Chapter 2) is ably summarised. With the commercial production of dienes such as butadiene, furan and their derivatives, and considering the wide variety of compounds which can serve as dienophiles, this review should stimulate the synthesis of hitherto unknown and inaccessible compounds by new applications of the Diels-Alder reaction.

The synthesis of aliphatic and aromatic amines by reductive alkylation (the introduction of alkyl groups into ammonia or a primary amine or secondary amine by means of an aldehyde or ketone in the presence of a reducing agent) is described in Chapter 3. By a suitable choice of conditions high yields of amines with the desired degree of alkylation can be achieved by this one step synthesis.

Methods for the synthesis of α -hydroxy-ketones of the general formula $R\cdot\text{CHOH}\cdot\text{CO}\cdot R'$, known as acyloins if R and R' are aliphatic residues and as benzoin if these are aryl residues, are discussed in Chapters 4 and 5. The synthesis of benzo-quinones by oxidation, discussed in Chapter 6, is also of value for the preparation of quinones from naphthalene and higher polycyclic hydrocarbons, as well as heterocyclic compounds. The selective hydrogenation of an acid chloride to the corresponding aldehyde in presence of a suitable catalyst, usually supported palladium, is discussed in Chapter 7; the Rosenmund reduction is probably the best method for converting acids to the corresponding aldehydes and has wide

applicability. The Wolff-Kishner reduction of a carbonyl to a methylene group by heating the semicarbazone, the hydrazone or the azine in the presence of an alkaline catalyst, described in the last chapter, is a valuable alternative for the more common Clemmensen reduction, and is to be preferred to the latter in the case of the compounds of the pyrrole and furan series which are sensitive to acids; compounds of high molecular weight are not amenable to reduction by the Clemmensen method, but the Wolff-Kishner reaction is applicable.

K. V.

Theory of Groups and Its Application to Physical Problems. By S. Bhagavantam and T. Venkatarayudu. (Andhra University, Waltair), 1948. Pp. xii+234. Price Rs. 20.

As Physics extends its frontiers further and further, various new types of Mathematics are pressed into service and every succeeding generation of physicists has to master more and more of these mathematical disciplines almost always under protest as History shows. There was a time when the infinitesimal calculus itself was thought of as a difficult subject, to be introduced only into advanced treatises and even then with an apology. British authors fought shy of Vector Analysis in the same way and even now it is sparingly used in English books. The Theory of Relativity made it necessary for physicists to master Tensor Analysis, and again we see it being slowly introduced into text-books, often in a disguised garb. And now we have Group Theory, against learning which even Dirac is reported to have protested. One regrettable result has been that we no longer have physicists like Lord Rayleigh who are familiar with both the theoretical and experimental branches of physics. The experimenter has to take the theorist on trust, while very often the theorist does not know and does not want to know what his symbols mean. But time has shown that learning a new type of mathematics will in general become inevitable as physics advances. It will be more graceful and less painful if the acquisition is not unduly put off.

We may congratulate the authors of the book before us for showing that Indians are not slow to learn and employ even such an arduous discipline as Group Theory. Another reason for our congratulation is that while most of the scientific books produced in India are cram-books and notes, this is a high class production resulting from original study and investigation. The book is further noteworthy

as to the large number of different problems treated, and so, whether we learn Group Theory or not, we can turn to the book for various useful results. We have here the results of the application of Group Theory to vibrations of molecules and lattices, atomic and molecular spectra, Raman Effect, Nuclear Spin, Crystal Optics, Optical Activity, Elasticity, Photo-elasticity, Piezo-electricity and Electrical Double Refraction. This list of applications should certainly convince even the most sceptical that learning Group Theory is worth while. It is also not an exaggeration to say that the book shows a collect on of useful information not easily to be found anywhere else within two covers.

While the copiousness of the information is one of the merits of the book, it is also the source of its chief weakness which is undue compression. Almost every sentence is a theorem or an important part of a proof, and the sentences run into paragraphs without halts, so that anyone who does know something of the subject will be bewildered. The equations are not numbered, and when references are made to previous treatment in the book, one does not know where to turn and has to search, sometimes at random. Figures are all too scarce and this adds to the difficulty of following the text. As an example of this, it will be seen that "Symmetry Operations and Point Groups" treated in twelve pages of small type with three pages full of figures in Herzberg's "Infra-red and Raman Spectra of Polyatomic Molecules," are here compressed into less than four pages of open printing with no figures. (The figures given in Chapter II are artistic, but not of much practical use.) In the same way most of the information given in Wigner's *Gruppen-theorie* from p. 63 to p. 78 is here condensed into pages 18-24. Chapter V of the book condenses almost half of the information in any book on Wave Mechanics (e.g., Pauling & Wilson's book) into 11 pages. One has to learn all about matrices as used in the book from three pages in Chapter IV. If only the authors had allowed themselves more space and arranged the matter in a more arresting way so as to make the chief results stand forth, the value of the book would have been enhanced to an appreciable extent.

The arrangement of the material does not show a logical plan; we oscillate from groups to lattices and jump to atomic spectra and back to groups. Some important parts of the theory are to be found thrust into appendices. The discussion of the relative merits of the theories

of Raman and Born is useful but does not seem to lead to any definite judgment, and occupies much space in the middle of the book. The attempt seems to have been to indicate as many applications of Group Theory as possible at any point that offered itself in the development of the book.

Misprints are really few. We have noticed minor ones on pages 44, 46, 97, 101, 127, 161 and 203. On pages 36 dV in $f_{\psi_1^* \psi_2} dV$ is said to be an element of 'phase space'. In Fig. 15 the letter O is not present.

References to other books and original papers are not given except a general list at the end of the Preface. It is therefore difficult to find the original contribution of the authors of the book, although there are indications to show that a good deal is original. We only wish that the condition of inflation and paper shortage evidenced by the price and the compression were soon removed so that the authors felt free to discuss the material at their leisure and provide it with the illustrations so necessary to understand the subject. The book would then be an even more valuable acquisition to a Physics Library. Even as it is, it is an essential and valuable contribution to the literature of Physics.

T. S. S.

The Basis of Chemotherapy. By Thomas S. Work and Elizabeth Work. (Oliver & Boyd Ltd., London), 1948. Pp. xx + 435. Price 26/- net.

The development of knowledge in the branch of chemotherapy has been so rapid during the past few years and the field covered by this development so varied that it is difficult for any individual to keep in touch with the progress in branches of science outside his speciality. Consequently when those who have spent some time in the study of this important subject are willing to co-ordinate their knowledge and present it in a concise and readable form they perform a service of great value. Work and Work have served two distinct purposes in writing this volume. Firstly, they have presented the knowledge available upon the chosen topic in a form intelligible to those whose activities may be along a wholly different line. Many chemists fail to realise how closely their investigations may be connected with other work which on the surface appears far afield from their own. This book enables us to form closer contact with works on the allied lines of research. The second purpose is to promote research in

the branch of science covered by the book by furnishing a well-digested survey of the progress already made and by pointing out directions in which investigation needs be made. To facilitate the attainment of this purpose enough references have been given so that any one interested can readily find access to the literature. The specialist does not need exhaustive bibliographic treatment, as he is already familiar with the material in his field. A critical selection has, therefore, been made on those papers which are important.

The reader is assumed to have a knowledge of the background of biochemistry, organic chemistry and microbiology. For the sake of continuity and brevity many aspects of chemotherapy are only mentioned. It is hoped, nevertheless, that this description will make available to the workers in this line the trends and meaning of a field in which much difficulty is caused by a great mass of conflicting data. A critical evaluation requires so much elaboration that the authors make no pretense to be exhaustive. They have tried to build up a composite picture of intermediary metabolism of living cells, particularly bacterial cells as shown by their nutrition requirements. A study in this direction may help in elucidating the mode of action of known chemotherapeutic drugs and in developing new ones. The authors have dealt with kinetics of enzymic reaction and the subject of enzyme inhibition, so that the reader is able to distinguish between various types of inhibition known to occur. Since enzyme inhibition is often a reversible process, it is often found that the growth inhibiting action of drugs on living cells can frequently be removed by the addition to the drug-cell-system of what is known as 'antagonists'. In the chapter on drug antagonism the authors have elaborately dealt with this factor which can bring about removal of drug from its site of action. A study of antagonism leads us also to the field of drug resistance. Drug resistance is a tool for the study of acquired character, inheritance, differentiation and the relation of gene to environment. The authors have to be congratulated for trying to explain these points very lucidly.

The underlying pattern of the book is a carefully prepared and informative historical survey of the topic, an interpretation of the present and latest development in the field and an indication of some of the unsolved problems still confronting the chemotherapists. The book is highly recommended to those engaged in the field of research in chemotherapy.

N. N. DE.

The Chemistry and Manufacture of Indian Dairy Products. By K. S. Rangappa and K. T. Achaya. (The Bangalore Printing & Publishing Co., Ltd., Bangalore-2). 1948. Pp. xi+189. Price Rs. 10.

The book contains a useful collection of data on Indian milk and milk products. Though several standard text-books on the technology and chemistry of milk and its products are available, these invariably include only the data obtained under conditions widely differing from those prevailing here. During recent years, a considerable amount of published literature on Indian dairy products has accumulated which is widely scattered and not always easily accessible. The authors have done a great service in bringing all these data together.

The book is divided into three broad divisions covering 14 chapters, and is supplemented by author and subject indexes. The methods of preparation of important dairy products are described. In a vast country like India various modifications are followed for preparing the same product, but the outlines given help to convey a fairly general picture. The composition and characteristics of Indian milk products are described in detail. Side by side, these data have been compared with the results obtained by workers in other countries. This helps to bring out clearly the outstanding points between the two. References up to the year 1948 have been included mainly from the authors' own work, but a few omissions are noticeable. At some points matter irrelevant to the subject of the book has been allowed to creep in, and the data for the composition of some of the less well-known products are not quite up to date. But apart from these few corrections of a minor nature, the authors have accomplished a difficult task with credit, considering the fact that this is the first time that such a publication has been compiled. The book fulfils a long felt gap and is sure to be widely appreciated by specialists and students. The printing and illustrations have been done clearly, and the book has a very attractive get-up.

NOSHIR N. DASTUR.

The Indian Association for the Cultivation of Science—Annual Report, 1947-48.

The first part of the report contains a brief review of the development plan, research personnel and other matters, the resumé of the scientific work done in the Association being given as an Appendix. The development plan seeks to create five new departments, viz., of

General Physics (Optics), Theoretical Physics, Organic Chemistry, Inorganic Chemistry and Physical Chemistry, as also to supplement the researches of the Department of X-Rays and Magnetism in the domain of Molecular Structures. The plan further contemplates that the researches carried out in the Association would be such as to find application in investigations of the physics and chemistry of High Polymers. Partial effect has already been given to the plan during the period under review by the appointment of two new Professors and providing each with a part of the approved research personnel.

The researches carried out in the Department of X-Rays and Magnetism under the M. H. L. Professor were mainly concerned with the studies of the extra-reflections in Laue photographs and their temperature variation, low angle scattering and structure analysis of phenanthrene crystals, radiographic study of coals, and X-ray studies of plastics, glass and fibres. The interesting work on the magnetic behaviour of dia- and para-magnetic substances especially in the form of single crystals has been continued. A systematic study of the magnetic and electrical properties of semi-conductors has also been undertaken. In the year under report, nine papers have been published.

The work done in the Optics Department is mainly concerned with the Raman spectra of various compounds in different states of aggregation and at different temperatures. The Department of Physical Chemistry was in existence for a period of three months only. Research work on polymerisation, kinetics of halogenation of sodium acetate in glacial acetic acid, surface active agents, etc., has been started.

R. S. K.

Practical Zoological Illustrations: Invertebrates. By W. S. Bullough. 32 cards. (Macmillan & Co., London), 1948. 15sh.

This set of semi-diagrammatic figures of typical invertebrates including *Branchiostoma* consists of 32 plates intended for the High School and first year University courses.

While the figures are useful as guides, the intermediate students of Indian Universities will feel the want of the sectional views of many of them. Particularly, *Lumbricus* is not of any use to them.

In *Nereis*, the head is not correctly drawn and also all the setæ are shown to be uniformly of the same type. The number of

bundles of Malpighian tubules, the gonapophyses and the correct delineation of the leg of *Blatta* are necessary.

In *Branchiostoma* (Amphioxus) the representation of gill slits and the nerve cord are not accurate.

It is hoped that the students who refer to these cards will make use of them as the author wishes them to be and not for copying them.

The printing of the cards is excellent. The price is unfortunately above the reach of the average Indian student. L. S. R.

Bulletin of the World Health Organisation: Vol. I, No. 2. (Sales Section, Palais des Nations, Geneva, Switzerland), 1948.

Report of the Expert Committee on (1) Tuberculosis, (2) Various Methods of Malarial Control, (3) Malaria Control in Egypt by Species-Eradication Method—A gambiense, (4) Cholera Epidemic in Egypt in 1947.

The Committee recommend organisational and control measures pertaining to various items under report. They recommend and give expert advice to countries which have not got proper Public Health Organization in order to combat major health problems such as malaria, tuberculosis, venereal diseases, which three diseases owing to their widespread prevalence, the Committee consider to be international rather than national or racial problems.

In the campaign against tuberculosis, the aim is to have a uniform standard in devising ameliorating measures, such as: (1) prevention, (2) case finding, (3) isolation and medical care, (4) social and economic protection of the afflicted. The salient features of the preventive method is training of technical personnel, expert advice, health education and propaganda to stimulate popular co-operation, besides (1) uniform procedure regarding research relating to preparation of tuberculin and tuberculin testing, (2) preparation and application of B.C.G. vaccine, (3) classification of tuberculosis, (4) x-ray interpretation of mass radiology, (5) evaluation of the new chemotherapeutic agents, etc. The Committee emphasises the importance of complete co-operation and co-ordination efforts on the part of the official and private agencies in order to obtain maximum results.

In the sphere of malaria prevention, the Committee gives first priority to mosquito control measures by drainage, application of D.D.T. and other suitable larvicides and insecticides. More research on these lines is needed. The Committee does not overrule the

importance of chemotherapy and chemoprophylaxis in the clinical control of epidemic malaria. Chemoprophylaxis however efficient is only considered a palliative measure. Therapy plays only a secondary role in the prevention of malaria. The Committee considers the importance of basic research on the following subjects, which should be encouraged in places where there are proper facilities, viz., Rockefeller Foundation, Indian Research Fund Association, and British Colonial Research Committee :—

1. Parasite—Animal relationship ; 2. Vector and insecticides ; 3. Epidemiology ; 4. Chemotherapy and chemoprophylaxis.

Applied research on the following is also recommended :

1. Choice of control method ; 2. Insecticides ; 3. Organization and equipment.

The Bulletin will be found very instructive to all Public Health Workers and may be commended to be read in the original.

K. P. MENON.

Industrial Hygiene and Toxicology. In two volumes. Prepared by a group of Specialists under the Editorship of Frank A. Patty, Director, Industrial Hygiene Service, General Motors Corporation, Detroit, Mich. Vol. I. (Interscience Publishers, New York, London). 1948. Pp. xxvii+531.

Hazards associated with various occupations such as mining, smelting, etc., were known from ancient time and certain precautions were taken to minimise the dangers from inhaling metallic dust and fumes. The first organised effort was the result of the introduction of labour legislation of the 19th century in England to reform the deplorable conditions of the workers in English Cotton Mills. Further reforms took place from time to time. Even so they were of the nature of the periodical examination of workers and prescribe remedial measures ; no attention was paid to improve environmental condition to prevent the occupational disease. Although there were many books published on the medical and legal aspects of occupational and industrial disabilities there are only a few books on industrial toxicology and still fewer on preventive engineering and control of occupational diseases. The present concept of industrial hygiene began to develop during the World War I as a result of ill-health and increased mortality among workers in munitions factories.

Organised efforts to impart instructions bearing industrial hygiene began by institution centres of study in American Universities, the first of which was established at Harvard Medical School where initially a Department of Applied Physiology was started. Other Institutions then began to spring up imparting instructions in industrial hygiene in collaboration with Doctors, Engineers and Chemists. Under the impact of World War II, industrial hygiene units were established in all the industrial States of U.S.A. Managements have realised the importance of improving the environmental conditions of the employees to ensure industrial efficiency and enhanced dividends. The present volume is a collective effort of various authors with thorough knowledge of the problems of efficient industrial conditions. The Editor is one who has to his credit vast experience in the field and is now the Director of Industrial Hygiene, General Motors Corporation, one of the largest single industrial organisations in the United States of America. The book is neatly got up and the textual matter is discussed in sufficient detail to afford an intelligent understanding of the various aspects of the subjects, which are classified as follows :—

1. Industrial Hygiene Retrospect and Prospect. 2. Industrial Hygiene Records and Reports. 3. Industrial Hygiene Survey and personnel. 4. Personal factors in competence and fatigue. 5. Environmental factors in fatigue and competence. 6. Physiological effects of abnormal atmospheric pressure. 7. Mode of entry and action of toxic material. 8. Sampling and analysis of atmospheric contaminants. 9. Radiant energy and Radium. 10. Ventilation. 11. Occupational dermatoses. 12. Visible marks of occupation and occupational diseases. 13. Fire and Explosive hazards of combustible, gases, etc.

The author stresses the need for the active collaboration of Engineers, Doctors, Chemists, Psychologists and Socialists all working together to achieve the common end of the well being of the workers and efficient industrial output. The book will be a source of valuable information to those who are interested in industrial welfare and organisation.

It is hoped that Volume II on Toxicology will be equally useful.

K. P. MENON.

SCIENCE NOTES AND NEWS

Infra-Red Photography of Forests

The "magic eye" of the infra-red film, peering down from the cameras of the Royal Air Force photographic reconnaissance aircraft, is to probe the secrets of Scotland's forests. Marked "high priority" on the R.A.F. Central Photographic Establishment flying programme for 1949 is the project for infra-red photography of forests in the Strathgryre-Loch Ard area.

The Survey is being undertaken for the Forestry Commission and it is expected that the use of infra-red photography from the air will enable the Commission to make a more exact classification of trees. At present it is possible to make a general classification from ordinary photographs sufficient to distinguish trees as either coniferous or deciduous. Infra-red photographs, however, are expected to show the state of growth of trees and to distinguish tree types within the coniferous or deciduous groups.

Some 200 square miles of forest have been selected as a testing ground for this experiment.

Need for Fundamental Research on Insects in India

In his Presidential Address delivered at the 11th Annual Meeting of the Entomological Society of India, held at Allahabad, on 4th January 1949, Dr. Hem Singh Pruthi stated that "On the whole India has not made many conspicuous contributions to the Science of Applied or Economic Entomology" principally because, "very little attention has been paid in India to fundamental work in Entomology, such as Insect ecology, physiology, morphology and taxonomy, on which alone good applied work can be based."

The Universities of India are the most suitable places for basic work, as in all other countries. In the laboratories of the Universities a great deal of work of an essentially basic nature on the problems of insect behaviour, genetics, heredity and evolution can be undertaken, besides morphology, physiology, ecology and taxonomy which will finally lead to proper and adequate application to economic problems in Entomology.

In the Indian Universities at present, the professors of zoology pay very little or no

attention to work on insects although in foreign universities teaching and research on insects occupy a place equal in importance to all other Science subjects. One of the reasons for this has obviously been that the heads of zoological departments are essentially zoologists with no special training in entomology and that suitable and competent entomologists are not recruited on to their staff; furthermore, trained Entomologists in India are extremely few.

The Department of Scientific and Industrial Research of the Government of India should consider seriously the establishment of a National Entomological Laboratory for work on basic aspects of the science of entomology. Such a laboratory with suitable and adequate staff could initiate all fundamental work on insects in close collaboration with the different universities and also train qualified men in entomology to serve as Readers in entomology in the Universities. The Indian Universities Commission should also make provision for teaching and research on insects in their Departments of Zoology.

Quarterly Bulletin of the Indian Standards Institution

The Indian Standards Institution has issued the first number of its Quarterly Journal, the *ISI Bulletin*. The Bulletin which is devoted to the publication of activities on standardisation in India and abroad caters to the needs of progressive industrialists, technologists, scientists and students in this field. In addition to the current news on Standardisation, the Bulletin publishes articles on technical subjects related to standardisation.

The first issue discusses the Standard Atmosphere for Testing in tropical and sub-tropical regions as distinct from the Standard Atmosphere in temperate regions. The advantages of adoption of this Standard Atmosphere in India are the simplicity of equipment, ease of operation and the comfort of the workers, which it answers.

A plea for Standardisation of Weights and Measures all over the country is made by Dr. Lal C. Verman, the Director of the ISI. He has also argued for the rationalisation, simplification and decimalisation of the fundamental units of length and mass, and

of the derived units of area, volume, etc., by introducing the decimal system, while retaining, as far as possible, the current terminology of Weights and Measures in India.

The progress of the Quality Control Movement in Industry, recently initiated by the ISI and the Indian Statistical Institute, forms the subject-matter of another article. Indian industry has begun to appreciate the need for adopting statistical methods of Quality Control in the manufacture of commodities. Courses have been established in Bombay for training technical personnel in the application of these methods. The ISI has reprinted the American Standard on "Control Chart Method of Controlling Quality during Production," for the use of manufacturers in India.

Seventh Pacific Science Congress

Some of the world's leaders in many branches of science gathered in New Zealand for the Seventh Pacific Science Congress.

About 120 scientists from over fifteen countries, including Britain, Canada and U.S.A. took part in the Congress which lasted until 23rd February, and which reviewed the whole field of science.

A transportation grant of \$ 20,000 was given by Unesco to the Congress, which made it possible for many scientists from countries bordering on the Pacific as well as from Norway, Holland and France to attend the meeting.

The last Pacific Science Congress took place in San Francisco, in 1939. The seventh meeting was originally due to meet in the Philippines in 1941 but was postponed on account of war.

Unesco Book Coupons in U.S.

The American Booksellers Association has been appointed to administer the Unesco Book Coupon programme in the United States, Mr. Milton S. Eisenhower, Chairman of the U.S. National Commission for Unesco, announced. This follows a recommendation by the Commission's Panel on Books.

The Book Panel's recommendation is the result of considerable study in order to integrate the Unesco Book Coupon Scheme into U. S. publishing operations.

The scheme was started by Unesco to overcome currency exchange difficulties and to enable educators, scientists, professional people and others in soft currency areas to purchase books and other publications in hard currency countries. Holders of these coupons pay for

their purchases in the money of their own country, and the coupons are redeemable by Unesco in the currency of the publisher's country.

The American Booksellers Association will transmit orders in the United States and arrange for redemption of the Unesco coupons.

CCRU Gives Institut Pasteur \$ 15,000

A gift of \$15,000 to the Pasteur Institute of France by the Canadian Council for Reconstruction through Unesco has been presented to Dr. Jacques Trefouel, Director of the Institute, by Dr. James A. Gibson, Chairman of the Executive Committee of the CCRU.

The money has been put at the disposal of the Institute to be used for the purchase of the scientific equipment.

In addition, the Institute has been offered for a period of three years, subscriptions to a number of learned and professional periodicals.

At a short ceremony at the Institute on 5th January, Dr. Gibson read a letter from Mr. Mackenzie King, until recently Prime Minister of Canada, saying this gift is designed to help the institution "to continue the scientific and humanitarian services which have earned for it the highest recognition throughout the world".

"The Council," Mr. Mackenzie King adds, "have requested me to convey to you this intimation of their desire to share in helping to alleviate some of the grievous difficulties arising from six years of war, and to help forward, in some small measure, the life-giving activities of the Pasteur Institute."

The CCRU is a national body which groups some sixty non-governmental organizations dealing with educational and social problems in Canada. It was created at the instigation of the Canadian Government and works closely with Unesco on problems of mutual interest.

Unesco Handbook of Opportunities for Study Abroad

Over 10,500 opportunities for international study in 166 subject fields in 27 countries are reported in a Handbook of Fellowships, Scholarships and Educational Exchange, called "Study Abroad," just issued by the United Nations Educational, Scientific and Cultural Organization.

The largest number of awards is available in the various branches of science, especially, medical sciences and public health, engineering, technology and chemistry. The second

most important subject is education, and the third social sciences.

In addition, the Handbook contains notes on the fellowship programme of the United Nations and the Specialized Agencies as well as summaries on the techniques of fellowship administration for those engaged in planning fellowship programmes. Fifteen per cent. of the reported opportunities are unrestricted both as to the nationality of eligible candidates and the subject field of study.

The aim of the publication is to increase the number and quality of candidates applying for fellowships, to suggest to prospective donors where new programmes may be developed, and to bring into perspective possible overlappings of emphasis and areas of outstanding need.

The reporting countries are Australia, Belgium, Burma, Canada, China, Colombia, Czechoslovakia, Ecuador, Eire, Finland, France, India, Italy, New Zealand, Norway, the Philippines, Portugal, South Africa, the United Kingdom and the United States of America. These have also supplied information on seven other countries.

The Handbook is published in English and French and will be distributed to Ministries of Education, National Commissions of Unesco, International Non-Governmental Organizations, Universities, Educational Periodicals and Libraries throughout the world. It is also on sale for individuals at Unesco House, Paris, and Unesco sales agents throughout the world at the price of \$ 1.00, 300 French francs or 5 shillings sterling plus postage.

Unesco Essay Competition

In order to stimulate public interest in its programme of work, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) has decided to conduct an essay and poster competition for young children in schools of member States.

The competition is entitled, "Together we build a New World". The entries should reach the Ministry of Education, Government of India by June 1, 1949, through the Provincial or State Government concerned from whom full particulars about the scheme can be obtained.

Sir Ben Lockspeiser

Sir Edward Appleton, K.B.E., K.C.B., will relinquish on the 30th of April, 1949, his appointment as Secretary to the Committee of the Privy Council for Scientific and Industrial Research.

The King has been graciously pleased to approve the appointment of Sir Ben Lockspeiser, M.A., M.I.Mech.E., F.R.A.S., to succeed Sir Edward Appleton.

Sir Ben Lockspeiser is at present Chief Scientist at the Ministry of Supply and will take up his new appointment on the 1st of May, 1949.

Grant to British Universities

In the coming Budget, Sir Stafford Cripps, Britain's Chancellor of the Exchequer, is providing £ 12,814,500 (Rs. 17.09 crores) for recurrent grants to universities. He announced this in reply to a question in the House of Commons. This amount includes provision for the additional expenditure which universities will incur in bringing into operation the revised scales of payment of teachers in the medical and dental schools.

The progress of the universities' scheme for physical education necessitates an increase in the amount required for non-recurrent grants and Sir Stafford is providing £ 4,750,000 (Rs. 6.33 crores) for this purpose, as against £ 2,600,000 (Rs. 3.47 crores) for the current year.

Entomological Society of India

The Eleventh Annual General Meeting of the Entomological Society of India was held on 4th January 1949, in the Zoological Lecture Theatre of the University of Allahabad. The President Dr. H. S. Pruthi delivered the Presidential Address on "Need of Fundamental Research on Insects in India".

The following resolutions were passed:

1. In view of the need for greater contacts and collaboration among entomological workers in different parts of India and between India and other countries of the world, the Entomological Society of India should periodically prepare a list of such workers engaged in Agricultural and other Applied Departments as also in various Universities, in India. Such a list should indicate the special interests of the individual workers and be published or otherwise printed for the information and use of all concerned.

2. In view of the great importance of fundamental research on insects, not only for solving various urgent problems in relation to crop, specially food production, the cottage industries of bee-keeping, silkworm rearing and lac culture, public health, forest management and conservation and life-stock improvement, but also for the better elucidation of

various scientific problems, such as those of animal (including human) behaviour, heredity and population, the evolution of forms, habits and communities, the laws of growth and migrations, etc., the Entomological Society of India feels that the establishment of a National Entomological Laboratory for fundamental researches is an urgent, national, scientific need. Such a Laboratory incidentally will provide the centre where research workers will occasionally gather from all parts of India for information, guidance and training and also for inspiration and thereby improve the standard of entomological research all over the country. The Society, therefore, recommends to the Government of India to establish a National Entomological Laboratory for India and draws the attention in this connection to the recent statement of the Prime Minister of India at the Indian Science Congress session at Allahabad, to the effect that India should undertake and do much more fundamental or basic work in science than has been the case so far.

In view of the great and undeniable importance of Entomological Research, both, to the developing economy of India as well as to Science in general, and in view of the acute shortage of trained Entomologists in the country specially needed for various nation-building activities, the Entomological Society of India recommends to the Indian Universities Commission to take steps to extend, improve and intensify Entomological training and research in the universities of India. In this connection the Society, if invited, would gladly assist the Commission by providing concrete plans and suggestions as to how the desired development of Entomological Research and training may be brought about.

The following Office-bearers were elected for 1949-50:—

1. *President* — Dr. H. S. Pruthi (New Delhi).
2. *Vice-Presidents* — Dr. E. S. Narayanan (New Delhi), Dr. D. R. Mehta (Kasauli), Dr. N. C. Chatterjee (Dehra Dun), Mr. M. C. Cherian (Coimbatore).

3. *Councillors* — Dr. D. D. Mukerji (Calcutta), Mr. Ramchandran (Coimbatore).

4. *General Secretary* — Dr. S. Pradhan (New Delhi).

National Institute of Sciences of India

At the Annual General Meeting of the National Institute of Sciences of India, held at Allahabad, on the 4th January 1949, the following were elected Office-bearers and Members of its Council for the year 1949:—

President: Prof. S. N. Bose (Calcutta). *Vice-Presidents*: Prof. A. C. Banerji (Allahabad), Maj.-Gen. Sir S. S. Sokhey (Bombay); *Treasurer*: Dr. C. G. Pandit (Delhi). *Foreign Secretary*: Dr. J. N. Mukherjee (Delhi); *Secretaries*: Prof. D. S. Kothari (Delhi); Dr. H. S. Pruthi (Delhi). *Editor of Publications*: Dr. S. L. Hora (Calcutta). *Members of Council*: Dr. K. N. Bagchi (Calcutta), Dr. S. K. Banerji (Delhi); Mr. S. Basu (Poona); Prof. H. J. Bhabha (Bombay); Prof. S. R. Bose (Calcutta); Dr. B. B. Dey (Madras); Prof. A. C. Joshi (Hoshiarpur); Dr. S. Krishna (Dehra Dun); Sir K. S. Krishnan (Delhi); Prof. S. K. Mitra (Calcutta); Dr. B. Mukerji (Calcutta); Mr. G. R. Paranjpe (Poona); Dr. M. Prasad (Bombay); Mr. J. M. Sen (Calcutta); Dr. A. C. Ukil (Calcutta).

The following distinguished Foreign Scientists were elected Honorary Fellows of the Institute:—

1. Prof. Louis de Broglie, Professor of Theoretical Physics, Poincare Institute, Sorbonne, Paris. 2. Prof. Hans von Euler, Emeritus Professor of Chemistry, Stockholm University, Stockholm. 3. Dr. Harlow Shapley, Director of Harvard Observatory and President of the American Science Association. 4. Prof. Georg Tischler, Botanical Institute, Kiel University, Germany.

The following have been elected Ordinary Fellows of the Institute:—

1. Dr. Jnanendralal Bhaduri, Lecturer in Zoology, Calcutta University. 2. Dr. S. Bhagavantham, Scientific Liaison Officer for India in the United Kingdom. 3. Dr. S. K. Chakrabarty, Director, Colaba and Alibag Observatories, Bombay. 4. Dr. D. Chakravarti, Lecturer in Chemistry, Calcutta University. 5. Dr. M. Damodaran, Assistant Director, National Chemical Laboratories, Delhi. 6. Dr. B. K. Das, Professor and Head of the Department of Zoology, Osmania University, Hyderabad-Deccan. 7. Dr. Kurien Jacob, Palaeobotanist, Geological Survey of India, Calcutta. 8. Dr. T. S. Mahabale, Lecturer in Botany, Royal Institute of Science, Bombay. 9. Dr. H. K. Mitra, Refractories Engineer, Tata Iron and Steel Co., Ltd., Jamshedpur. 10. Dr. Kalidas Mitra, Officer-in-charge, Nutrition Scheme, Public Health Laboratories, Bihar, Patna. 11. Dr. A. H. Pandya, Director, Hindusthan Aircraft, Bangalore. 12. Dr. N. Parthasarathy, Geneticist, Indian Agricultural Research Institute, New Delhi. 13. Dr. C. Racine, Professor and Head of the Department of Mathematics, Loyola College, Madras. 14. Dr. K. C. Sen, Director, Indian Dairy Research Institute, Bangalore. 15. Dr. R. S.

Varma, Reader in Mathematics, Lucknow University, Lucknow.

Awards of the following Research Fellowships were made:—

Imperial Chemical Industries (India) Research Fellowship:

Dr. S. N. Ghosh (Physics), Calcutta University, Calcutta. Dr. L. R. Row (Chemistry), Andhra University, Waltair.

National Institute of Sciences Senior Research Fellowship:

Dr. A. P. Kapur (Zoology), Zoological Survey of India, Calcutta.

Reports on Scientific Advances during World War II

Dr. Alexander Wolsky, the Principal Scientific Officer of UNESCO, New Delhi, has advised us that the Pontifical Academy of Science (Vatican, Rome, Italy) has undertaken to compile a general report of the scientific research work accomplished throughout the world during the critical years of the second world war, when scientific communications were greatly disrupted. "The initiative is in conformity with the august wish of the Holy Father to see international scientific communication restored promptly and on a large scale, thus contributing to ease the strained relations existing between peoples, as well as to enrich the fund of human knowledge by new and useful elements". It is proposed that the general report will be divided into a series of particular reports referring to one or more countries and will treat the various branches of science on the basis of the papers published in the well-known scientific journals or reviews, as will be selected by the respective authors of the reports. Dr. Wolsky has recently received 18 such reports the titles of which are listed below and the language is also mentioned in brackets:—

1. *La Physique Du Noyau: Dans Certains Pays D'Europe Durant La Periode 1939-45* (French). By C. Manneback.

2. *Progres Recents: De La Theorie Quantique Des Champs Et Du Meson* (French). By C. Manneback.

3. *The Liquid State: Position of the Problem in the various countries since 1936 until 1945.* (English) By Andrew Van Hook.

4. *Development of Mathematical Biophysics in U.S.A. from 1939 to 1945 inclusive* (English). By N. Rashevsky.

5. *Spektrochemie: Die Wichtigsten Spektrochemischen Veröffentlichungen in Deutschland: Aus Den Jahren 1939, 1940, 1941, und 1942.* (German). By A. Gatterer.

6. *La Meccanica Razionale: E La Fisica Mathematica Nell' Italia Centrale E Meridio-*

nale Dal 1939 A Oggi (April 1946) (Spanish). By Antonio Signorini.

7. *La Meccanica Razionale E La Fisica Mathematica Nell' Italia Settentrionale E In Svizzera Dal 1939 al 1945* (Spanish). By C. Somigliana, B. Finzi, C. Cattaneo.

8. *La Geometria Differenziale in Italia* (Dal 1939 al 1945) (Italian). By Piotra Ruzano.

9. *Geometria Algebrica: Nei Paesi Anglo-Sassoni* (Dal 1939 al 1945) (Italian). By Beniamino Segre.

10. *Analisi Matematica in Italia: Nel Campo Complesso* (Dal 1939 al 1945) (Italian). By Aldo Ghizzetti.

11. *La Geometria Algebrica in Italia* (Dal 1939 a tutto il 1945) (Italian). By Fabio Conforto e Guido Zappa.

12. *Ottica Fisiologica: E Problemi Della Visione Nei Vari Paesi Dal 1939 al 1945* (Spanish). By Francesco Schupper.

13. *Lavori Geodetici Italiani: Dal 1° Gennaio 1939 Al 31 Dicembre 1945* (Italian). By Giovanni Boaga.

14. *Accion De La Tiroides Sobre El: Metabolismo de los Hidratos De Carbono Y En La Diabetes* (Resumen de los Trabajos De 1939 A 1945) (Spanish). By Bornardo Houssay.

15. *Progress in the Knowledge of Gram-negative Enteric Pathogenic Organisms during the years from 1939 to 1945* (English). By Oscar Felsenfeld Viola Mac Young Phyllis Conner.

16. *La Produzione Cancerologica Sperimentale in Italia e in Germania Lal 1940 al 1945* (Italian). By Pietro Rondoni.

17. *L'Aerodinamica in Italia* (Dal 1939 al 1945) (Italian). By Enrico Pistolesie Carlo Ferrari.

18. *I Motori Aeronautici in Italia* (Dal 1939 al 1945) (Italian). By Antonio Capetti.

The periods covering the reports are also mentioned along with the titles. The bibliographies appended with each of these publications appear to be useful to the scientific workers in the respective fields.

These publications are being brought to the notice of our readers in the hope that these might offer an idea of the work carried out particularly in the countries of Europe, which were cut off from contacts with other countries in the course of the last world war.

Only one copy each of the reports is available at the Office of the UNESCO at Delhi for personal inspection, by those interested but in case of requests from long distances it might be possible to send them for perusal and speedy return.

ERRATUM

Note entitled "Varagu" (Pasupalum Scrobiculatum)

Curr. Sci., 1948, 17, p. 367, column 2, line 4—
'Saponification value' read 170.7 for 107.7.

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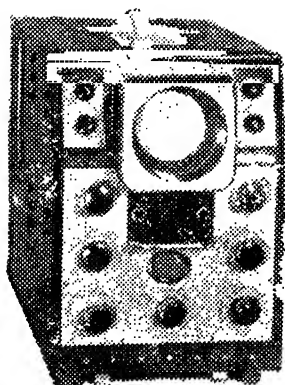
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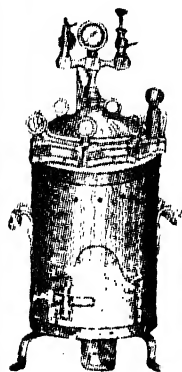
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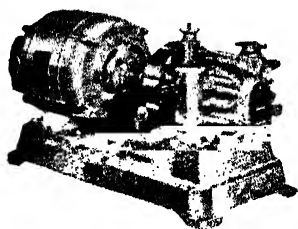
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Current Science

Vol. XVIII]

APRIL 1949

[No. 4

	PAGE		PAGE
<i>The Far-Eastern Conference on Forestry and Timber Utilisation</i>	101	<i>A Re-Examination of some Aspects of Puranas and Archæans of South India</i>	112
<i>British Industries Fair</i>	105	<i>Soil-Borne Plant Diseases and Their Control</i>	114
<i>Professor Albert Einstein--The Internationalist.</i> PROF. NIELS BOHR ..	106	<i>Some Aspects of Tuberculosis in India and Measures for Its Control</i> ..	115
<i>Indian Society of Agricultural Statistics</i> ..	107	<i>The Place of Physiology amongst the Modern Sciences and the Importance of Its Study to the Nation</i>	117
<i>Dietetic, Hepatic Lesions and Protein Deficiency.</i> M. V. RADHAKRISHNA RAO, N. C. DATTA AND L. S. KRISHNAN ..	108	<i>Obituary—</i>	
<i>Organolites in Industry</i>	110	<i>James Hornell, 1865-1949</i>	118
<i>Haffkine Institute of Preventive Medicine, Bombay</i>	111	<i>Letters to the Editor</i>	119
<i>Indian Journal of Helminthology</i> ..	111	<i>Reviews</i>	135
		<i>Science Notes and News</i>	141

THE FAR-EASTERN CONFERENCE ON FORESTRY AND TIMBER UTILISATION

THE Far-Eastern Conference on Forestry and Timber Utilisation which has just concluded its session at Mysore is the Third Regional Conference to be organised by the Food and Agricultural Organisation of the United Nations. The first of these was held in 1947 in Czecho-Slovakia to cater primarily to European needs; the second was held in 1948, in Brazil, for the Latin American countries; and now, the third of these, devoted to the problems of the Asian and Pacific countries, has completed its work. It may be added that the Ecafe also suggested the convening of the Conference. India offered to be the host

and the Government of Mysore provided the necessary facilities at Mysore City which has thus had the privilege of being the venue of the first International Conference in its long history.

Delegates from Burma, Ceylon, France, India, Malaya, Netherlands, New Zealand, Pakistan, Philippines, Siam and the United Kingdom attended the Conference. Observers were present on behalf of Bhutan, Indonesia, Korea, Nepal, Portugal, Unesco, Scap (Japan), and the International Meteorological Organisation. Russia was a notable absentee. The Indian Delegation was led by Sir T. Vijayaraghavacharya,

and on his later election to the Chairmanship of the Conference, by Mr. A. P. F. Hamilton, I. G. of Forests, whose colleagues on the Delegation were Mr. C. R. Ranganathan and Mr. R. Bhadran. The Delegation was assisted by Dr. S. Kamesam and a number of Chief Conservators of Forests of the Indian Provinces and States as alternate Delegates and Advisers. M. Marcel Leloup, Director of Forestry, FAO, was in general charge of the Conference assisted by Dr. Morris A. Hubermann, Secretary-General, and Dr. D. Y. Lin and Dr. Leslie Vernell, Technical Secretaries. Mr. M. A. Muthanna, Chief Conservator of Forests, Mysore, was, besides his place in the Indian Delegation, in charge of the local arrangements of the Conference.

The general pattern of work for the Conference was on the same lines followed in the two earlier regional conferences, *viz.*, to assess the forest assets and liabilities of each region, to estimate the gap between the supply and the demand for forest products, discuss remedies and to set up machinery and to implement on a regional basis, the recommendations of the Conference.

The Conference for which elaborate preparations had been made by the Governments of India and Mysore opened at the Cheluvamba Mansions, Mysore, on the 28th March 1949. The Hon'ble Mr. Jairamdas Doulatram, Minister for Food and Agriculture, inaugurated the Conference. His Highness, the Maharaja of Mysore in his gracious speech expressed his pleasure to welcome such a distinguished international gathering to the capital of the State, referred to the salient features of Mysore Forests and expressed his hope that the deliberations of the Conference would be crowned with success. Pandit Jawaharlal Nehru, Prime Minister of India, expressed his great regret at being unable to be present, and his inspiring message wishing success said, "To the people in the East, as

indeed in the whole world, the numerous problems of Forestry hold out a great challenge. It must be met if the world is to be made a better place to live in. Fundamentally, the problems are the same in all countries and I am sure this Conference will not only provide the means of pooling the world's knowledge and experience of Forestry but will also, by bringing together the foresters of the East, strengthen the Brotherhood of Forestry and the bonds of friendship which already exist among the Nations participating. I send my best wishes for the success of the Conference." Mr. Jairamdas Doulatram, in his speech, felicitously indicated how appropriate it was that the first International Forestry Conference was held in India, which led the Asian countries in some aspects of forest technique and administration and whose wise men had turned to and not away forests for spiritual solace. He referred at the unwisdom of planning for agricultural self-sufficiency without adequate protection of the soil. He pleaded for a rational appreciation of the rural and the industrial demands made on forest resources and concluded by freely offering the facilities available in and the results garnered by India in forestry research.

Mr. Norris E. Dodd, Director-General of the FAO, in his message, dwelt on the interdependence of the well-being of the land and the community, while M. Marcel Leloup, Director of Forestry, FAO, explained the magnitude of the problems they had to face in Asia and the machinery needed to translate the recommendations of the Conference.

The Conference, after electing its permanent Chairman, Sir T. Vijayaraghavacharya (India), proposed by Pakistan, seconded by Burma and unanimously elected, decided its rules of business under a steering committee which also acted as the credentials committee. Then, splitting its work amongst a number of expert committees,

resolutions were drafted and, after critical discussion, were finally adopted by the plenary sessions of the Conference, on the following subjects:—(1) Forest Resources; (2) Forest Policy; (3) Soil Conservation; (4) International Control in Erosion Control; (5) Forestry and Weather; (6) Control of Grazing; (7) Roving Agriculture; (8) Large-scale Afforestation and Reforestation; (9) Domestic Needs; (10) Increased Production; (11) Balancing Supplies and Demand; (12) Distribution of Timber; (13) Standardisation and Grading; (14) Forest Inventions; (15) Enumeration Methods; (16) Minor Forest Products; (17) Statistics; (18) Research; (19) Exchange of Information; (20) Dissemination of Information; (21) Training and Education and (22) Conservation of Wild Life.

While considerations of space unfortunately preclude us from reproducing the text of all the resolutions *in extenso*, even the listing of the titles of the subjects dealt with indicate the range and comprehensiveness of the deliberations. This is not surprising, as the preamble and the constitution of the Food and Agricultural Organisation of the United Nations include: raising standards of living, securing improvements in the efficiency of production and distribution and bettering the conditions of rural populations. And, forestry touches so broad a front at many, many points.

The recommendations of the Conference naturally fall into two categories, *viz.*, the immediate needs and the long-term requirements. The former have an element of sameness all over the world. Forests have been cut, in many instances grossly overcut, during the war years in pursuance of 'win the war at any cost' policy. In forestry, the first tenet is conservation and conservation is the first casualty in any war. And these over-exploited forest resources are now called upon and provide the accumulated needs and pent up demand of this

period of colossal material destruction. And since forest products form part of the goods ranging from aeroplanes to matchsticks, the magnitude and complexity of meeting the needs of a starved world will become clear.

While the Conference took note of these extremely urgent needs and made specific recommendations to meet them, even more valuable was its contribution for the long-term rehabilitation and development of the forest resources of the region. Forestry is, in the best sense of the term, the best of investments but long dated. And, nemesis for lapses in forestry is not always swift or readily visible but terribly sure. These characteristic elements of forestry make it peculiarly difficult for uninitiated public opinion to appreciate or sometimes even recognise the implications of indifferent forest management. The temptation to cash in now the forest benefits that rightly belong to posterity is always there; and to index and measure the apparent efficiency of forest management by the fallacious yardstick of immediate financial return. These are matters of such grave import that the Conference rendered signal public service in dealing with them in its first resolution which reads as follows:

"The Importance of Forest Resources.

"The Conference,

"Recognising, that forests, as renewable, are essential to a country's agricultural life, industrial development, economic stability and national security;

"Recognising also, that forests and forest products both major and minor are essential to the life of the rural and urban population;

"Calls the attention of the governments of all countries of the region to the need for dynamic policies for the conservation, development and utilisation of forest resources, according, to the needs and possibilities of each country;

"Declares that any failure by governments to accord due recognition to the great value

of forest resources will have disastrous consequences for the economy of the country, both rural and industrial;

"Urges governments so to manage their forests as to serve the rural and urban population and thus enlist the support of the masses for the implementation of a sound policy for the protection and development of forests, even though this may involve some restriction on the action of individuals in the interests of the community as a whole. Thus the precious heritage of forest resources can be passed on unimpaired from generation to generation;

"Recommends that the attention of the governments of the region be drawn to the desirability of giving a high priority in their national financial and economic plans to the claims of forestry and the improvement of harvesting facilities."

We should like to draw attention to three other resolutions passed at the Conference and of special importance to India.

Resolution III deals with the menace of soil erosion and recommends, *inter alia*, the setting up in each country a central authority for the co-ordination, in both planning and execution, of land utilisation policies. The pressure on land of population, the planning and construction of vast irrigation and multipurpose River projects and the fact that in a vast country like ours the watercourses of many of these rivers lie within the control of different provincial authorities render it imperative that we have recourse to some central authority in such matters if the insidious and terrible chain of events consequent upon soil erosion is to be insured against. Also, even within a given province, the clamour for land cultivation at the expense of forest lands is a development which must be sternly put down. Taking the country as a whole, the area under forest is well below the safe minimum of about 25 to 30 per cent. of the land area, and it would be very short-sighted policy indeed if our effort at self-sufficiency in food should make inroads

into our already inadequate forest areas—losing sight of the basic fact that forestry and agriculture are two different methods of utilising the common capital of both, *viz.*, the soil.

Resolution XVIII makes recommendations on the important subject of forest research. This is an important aspect of forestry in which this country has good reason to take modest pride but no ground whatever to be complacent. Dehra Dun is on the international map of forest research centres. But, the point is that while Dehra Dun is good, it is not alone sufficient to cover the needs of this vast country. Dehra Dun should be the focal point from which the traditions and experience of this premier institution should permeate a number of co-ordinated regional research centres strategically located over this subcontinent. It is pleasant to record that the Indian offer to co-operate fully by placing her available research facilities and experience at the disposal of the member nations at the Conference was appreciated.

Finally, we should like to refer to the question of forest education which is dealt with in Resolution XXI. Here again, what we have is undoubtedly good but demonstrably insufficient. And there are many who believe that forest education in India is much too expensive. The Indian Delegation made a positive contribution to the deliberations of the Conference on this subject. All our plans and machinery for forest education have been hemmed in by two considerations, to provide professional foresters, and to provide such professional foresters to man the forestry services—almost exclusively governmental. The time is now ripe to loosen these restrictive bonds. The ideal to be aimed at would be that while first-rate facilities should continue to be available to train the professional forester, we should also establish educational facilities whereby elementary forestry may take its due place as a subject of liberal education in the curricula of universities. Finland

presents a fine example of what could be done in this direction. Then, again, the forests are getting to be increasingly important as the store-house of industrial raw material to be *processed* into consumer goods. This trend has created a demand for the services of the specialist who, with a grounding in the fundamentals of forestry, is called upon not to manage forests, but run forest industries. The facilities for such specialised training are conspicuous by their almost total absence in our country. And, here, the U.S.A., Canada and Germany could give us valuable lessons.

The fact that such packed agenda was disposed of within the course of some eleven working days was a tribute as much to the efficient and business-like organisation and the preparatory technical work as to the ability, tact and genial personality of the distinguished Chairman, Sir T. Vijayaraghavacharya, to whose work a chorus of tribute was paid by the delegates at the close of the Conference. The Conference was also fortunate in another respect. It was singularly free from rivalries and 'lobbyings'

which make some international gatherings a nightmare. Foresters naturally form a fraternity; they fell, with axes but have no axes to grind and no secrets to jealously guard against prying eyes and ears. They are ready indeed anxious to share their experience and to pool their knowledge. All this contributed to the amity and dignity of the international gathering.

As a postscript, it may be added that one immediate and concrete sequel to this Conference is the setting up of a regional forestry office at Bangkok, with Dr. D. Y. Lin as its first Director. The Indian Delegation strongly urged the claims of India for the location of this office both on geographical grounds and on the basis of past experience and the great facilities for research which India affords. We are naturally disappointed that the verdict of the Conference in this matter went against India, but, this by itself is not a serious matter and we wish every success to the new office and its distinguished Director at Bangkok in the discharge of their responsible duties in the service of Forestry.

BRITISH INDUSTRIES FAIR

THE biggest trade fair in the world—the British Industries Fair—to which thousands of visitors and buyers flock from all parts of the world, will be held this year at London and Birmingham from May 2 to May 13.

Representative of all trades and industries in Britain, this year's Fair is expected to surpass all previous exhibitions in the quality, range and beauty of its exhibits.

India's interest in the British Industries Fair of 1948 was, in comparison to other countries, markedly high. Over 700 buyers attended the London section alone in a total of 12,505 buyers from nearly 100 countries. And the coming Fair is likely to attract even more buyers from India.

The lighter industries will exhibit in London, while the Engineering and Hardware Section will be organised, as usual, in Birmingham.

The 1949 Fair will include a major display by the Textile and Clothing industries and is expected to be the best exhibited so far.

Other industries exhibiting in London will include brushes and brooms, chemicals, chemists' supplies, cutlery, jewellery, plated ware, silverware, watches and clocks, domestic suction cleaners, fancy goods of all types, foodstuffs, beverages and tobacco, furniture, leather and leather goods, musical instruments, office machinery and equipment, plastics, pottery and glassware, printing and bookbinding machinery, radio sets and allied trades, scientific and photographic equipment, sports goods, stationery and paper, toys and games and other general and sales services.

At Birmingham, the buyer will find every conceivable item of equipment needed for the building trade, for electricity and engineering of all categories, for transport, for gas, for mining, colliery, road and oilfield. There will be a section for hardware, ironmongery and brassfoundry and also metals of all types—in fact everything that India needs for building up her own industries and modernising her state.

PROFESSOR ALBERT EINSTEIN—THE INTERNATIONALIST

PROFESSOR NIELS BOHR

It is most natural and appropriate that the United Nations Educational, Scientific and Cultural Organization should pay a tribute to Albert Einstein on the occasion of his seventieth birthday. Indeed, for the whole of humanity Einstein's name stands pre-eminently for that search to extend our knowledge and deepen our understanding which is not only the spirit and object of science, but which forms the very foundation of all human civilization.

Through Albert Einstein's work the horizon of mankind has been immeasurably widened, at the same time as our world picture has attained a unity and harmony never dreamed of before. The background for such achievement is created by preceding generations of the world-wide community of scientists and its full consequences will only be revealed to coming generations.

Man's endeavours to orient himself in his existence beyond the immediate necessities of life may be traced back to the widely spread birth-places of our civilization like Mesopotamia, Egypt, India and China and, above all, to the small free communities in Greece, where arts and science rose to a height unsurpassed for long ages. During the Renaissance, when all aspects of human culture again flourished, most intense and fruitful contacts between scientific endeavours all over Europe took place, as we are reminded by the names of Copernicus, Tycho Bræhe, Kepler, Galileo, Descartes, Pascal and Huygens, men of many countries whose achievements created the basis of the edifice of which Newton's genius is the pinnacle.

NEW INSIGHT

The great advance of natural philosophy at that time, which came to exert a deep influence on all human thinking, consisted above all in the attainment of a rational description of mechanical phenomena based on well-defined principles. It must, however, not be forgotten that the idea of absolute space and time formed an inherent part of the basis of Newton's work and that also his well-known concept of universal gravitation constitutes an element so far not further explainable,

It was just at these points that Einstein initiated quite a new development which, in an unforeseen manner, has deepened and rounded our views and given us new insight and power of comprehension.

The way leading to this turning point was paved by the development during the nineteenth century, of our knowledge of the electromagnetic phenomena which has brought such a great increase in human facilities and created the modern means of world-wide communication.

This development was furthered by an ever more active international co-operation, the extent of which is recalled by such names of many nations as Volta, Cersted, Faraday, Maxwell, Hertz, Lorentz and Michelson. Gradually, however, the growth of knowledge in this new field disclosed more and more clearly the difficulties and paradoxes inherent in absolute space-time description.

A quite new outlook was here opened by the genius of Einstein, who changed the whole approach to the problems by exploring the very foundation for the description of our experience. Thus, Einstein taught us that the concept of simultaneity of events occurring at different places was inherently *relative*, in the sense that two such events which to one observer appear simultaneous, may seem to follow each other in time from the standpoint of another observer.

This recognition of the extent to which the account of phenomena depends essentially on the motion of the observer proved, in the hands of Einstein, a most powerful means of tracing general physical laws valid for all observers.

In the following years, Einstein even succeeded in attaining a view-point wide enough to embrace the gravitational phenomena, by extending his considerations to the comparison of the effects experienced by observers with accelerated movement relatively to each other. Out of Einstein's novel approach to the use of space and time concepts grew gradually a wholly new attitude towards cosmological problems, which has given most fertile inspiration for the exploration of the structure of the universe.

Although simplicity and beauty are the principal marks of Einstein's fundamental ideas, the detailed treatment of complex problems often demands the use of abstract mathematical methods like non-Euclidean geometry. As often before, it has here been most fortunate that such tools were ready as the fruit of the work of older mathematicians.

The names of Gauss, Lobachevsky, Bolyai, Riemann, Ricci and Minkowski here again remind us of the fertility of international co-operation in all fields of science. And the same may be said of Einstein's other outstanding work.

For example, his explanation of the irregular motion of small bodies in liquids, based on the ideas of Maxwell, Boltzmann, Smoluchowski and Gibbs, made it possible for Jean Perrin accurately to count the atoms of which substances are built.

We find ourselves to-day in a new epoch in physical science, in which experimental discoveries and theoretical methods have led to a rapidity and fecundity of progress made possible only by international co-operation of an unprecedented activity and extent.

It is not possible in this occasion to disentangle the contributions of individual workers, but mention must be made of the guidance, at almost every step, which Einstein has given us by his Relativity

theory and by his analysis of elementary quantum phenomena.

Altogether, this short exposition of Einstein's scientific achievements aims at giving an impression of the extent to which his originality of outlook has made him an innovator in science. At the same time, I have attempted to remind you that all scientific endeavours are parts of a great common human enterprise.

The gifts of Einstein to humanity are in no way confined to the sphere of science. Indeed, his recognition of hitherto unheeded assumptions in even our most elementary and accustomed concepts means to all people a new encouragement in tracing and combating the deep-rooted prejudices and complacencies inherent in every national culture.

With his human and noble personality, characterized equally by wisdom and humour, Einstein himself has through all his life, and not least in these latter years, worked for the promotion of international understanding. On his seventieth birthday evidence of the veneration and gratitude our whole generation owes to him will reach Einstein from many sides, and we all want to express the wish that the hopes for which he has lived and worked may be fulfilled to the benefit of all mankind.

—By courtesy of Unesco "Courier",
March, 1949.

INDIAN SOCIETY OF AGRICULTURAL STATISTICS

A NEW organisation, the Indian Society of Agricultural Statistics, has been formed. The Society is devoted to the 'Study of and research on, Statistics and applications thereof to Agriculture, Animal Husbandry and Agricultural Economics'. The Society is open to all persons and institutions interested in Statistics and its application. Membership fee per annum is Rs. 18/ in India and Rs. 20/ outside.

The first Journal of the Society published in Jan. 1948 contains many useful contributions, technical and non-technical, with brief summaries in Hindi language. The Minister for Food and Agriculture and the Minister for Finance, Government of India, have in their addresses expressed great anxiety of the Government of India to improve the statistical organisation in India. Dr. Sukhatme's article on crop-

surveys should convince the Governments about the utility of modern statistical methods in crop-estimation work. The fact that the duty of collection and interpretation of data should be entrusted to the technically trained is obvious from the several articles appearing in the Journal.

Contributions on the statistical theory by Messrs. R. D. Narain, Panse and Bokil and Kishen show that this Journal is in no way inferior from the technical point of view to the best of the American and British Journals. The Editors of the Journal, Dr. P. V. Sukhatme and Dr. V. G. Panse, deserve to be congratulated.

We sincerely welcome the Journal and join the Editors in appealing to Government, Universities, Research Institutes and the public to extend their fullest co-operation and generous support,

DIETETIC HEPATIC LESIONS AND PROTEIN DEFICIENCY*

M. V. RADHAKRISHNA RAO, N. C. DATTA AND L. S. KRISHNAN

(Department of Nutrition and Experimental Pathology, Haffkine Institute, Bombay)

AS a result of recent researches, a new orientation has been given to the etiology and treatment of liver diseases in general and 'cirrhosis of liver' in particular. Experimental evidence has accumulated to suggest that 'cirrhosis of liver' may be a deficiency disease. Malnutrition is widely prevalent in India and the incidence of 'cirrhosis of the liver' is fairly high in certain parts of the country. It was pointed out by the senior author (1936) that "dietetic deficiencies appear to be the important factors in the causation of the disease".

In view of its practical importance, a study of 'cirrhosis of the liver' both in its clinical and experimental aspects of the problem, was undertaken under the auspices of the Indian Research Fund Association, in the Haffkine Institute, Bombay, since July 1944.

Experimental work was designed to study the effect of protein deficiency, with and without supplements of the vitamins of the B₂ complex on the histological and biochemical changes in the liver of rats, while the clinical investigation was mainly concerned with the evaluation of the effect of treatment of decompensated portal cirrhosis with high protein, high caloric diets with vitamin supplements.

1. Experimental Hepatic Cirrhosis

(a) *Effect of Vitamin B₂ Complex deficient diet with different levels of protein on the liver:* Casein was the main source of protein and the basal diets contained varying levels of the protein, namely 18, 10, 8 and 5 per cent. casein respectively. Animals in this group were deprived of all the vitamins of the B₂ complex. A total of 108 rats were used in this experiment in the different groups.

The growth and survival of the rats depended largely on the amount of casein in the diets. On the 5 per cent. casein diet, the animals did not survive for more than 2 to 3 months. In the other groups, the average life of the animals increased as the casein in the diet was raised.

The relationship between liver weight and body weight of the rats was found to vary according to the level of casein in the diets. In general, as the percentage of casein in the diet was decreased, the average liver weight per 100 g. body weight was increased.

The estimation of water, fat and protein content of the liver showed that this increase in the weight of the livers in the low protein groups was not due to accumulation of fat alone; for, there were significantly larger amounts of water and protein present as compared to normal liver.

(b) *Histological findings:* In animals receiving 18 to 10 per cent. casein diets respectively, the liver parenchyma showed moderate to severe fatty infiltration, particularly around the central veins. Traces of ceroid pigment was also visible in these areas. In the 8 per cent. and 5 per cent. groups, extensive fatty infiltration, more marked around the central veins was seen. An interesting feature in the 8 per cent. protein group was the appearance of replacement fibrosis, patchy in distribution around the central veins. In certain cases this was more marked and there was a tendency for the formation of pseudolobules. Animals receiving 5 per cent. protein diet did not show any marked replacement fibrosis. None of the animals in any group showed massive necrosis.

(c) *Control diets:* The composition of these diets was similar to the above and likewise the level of casein in diets varied from 5 to 18 per cent. respectively; the only difference being that each animal received in addition 0.5 g. of dried brewer's yeast per day as a source of the vitamins of B group.

In this group there was no significant difference in the amount of water, fat and protein content of the liver, except in the 5 per cent. group which showed slight increase in the water and fat content.

Histological findings

Animals receiving 18 and 10 per cent. casein diets with supplements of yeast showed normal structure of the hepatic parenchyma, while those receiving 8 and 5 per cent. casein showed slight fatty infiltration around the central veins. Fibrosis of

* A paper read before the Medical and Veterinary Section of the 36th Session of the Indian Science Congress, held at Allahabad in January 1949.

the liver was altogether absent in these groups of animals even after prolonged feeding of the diets.

2. Effect of restricted intake of protein [casein] in an otherwise adequate diet on the histological and biochemical changes in the liver of rat.

An interesting feature of the previous experiment was the absence of massive necrosis of the liver on protein-deficient diets. Himsworth and Glynn (1944) however, have claimed to have produced massive hepatic necrosis and its sequence in rats by limiting the intake of casein between 200-500 mg. per rat per day. They found that the amount of fat, carbohydrate, minerals or vitamins in the diet did not have any influence on the production of hepatic necrosis.

It was therefore thought worthwhile, to study the histological and biochemical changes in the liver of rats on restricting the daily casein intake at different specific levels in an otherwise adequate diet.

The average results are given below :—

Daily casein intake	Initial weight in g.	Final weight in g.	Calories in take	Liver wt. g./100 g. body wt.	Water g./100 g. body wt.	Fat g./100 g. body wt.	Protein g./100 g. body wt.	Asn g./100 g. body wt.
(a) 1.2 g.	37.8	170.3	32.66	3.24	2.28	0.17	0.65	0.05
(b) 0.6 g.	37.5	149.5	28.6	2.87	2.04	0.17	0.55	0.04
(c) 0.4 g.	36.0	139.0	26.7	3.16	2.19	0.31	0.51	0.04
(d) 0.2 g.	38.8	89.0	19.3	4.16	2.81	0.48	0.65	0.05

The experiment was continued for more than 150 days. The growth of the animals paralleled the daily casein intake. The animals receiving a maximum of 1.2, 0.6 and 0.4 g. casein daily were quite healthy and normal and there were no signs of vitamin deficiency in any case, whereas those receiving a maximum of 0.2 g. casein showed considerable emaciation, loss of hair over the body and in general appeared weaker. There was no edema or ascites in any case.

From the results of the liver analysis given in the above table, it will be seen that the liver weight per 100 g body weight shows a definite increase as the daily intake of casein was reduced. The amount of liver fat per 100 g. body weight also showed an appreciable increase as the intake of casein was progressively reduced.

The results of the total plasma protein concentration and the choline content of the liver of rats in the different groups are shown below :

Daily protein (casein) intake	1.2 g.	0.6 g.	0.4 g.	0.2 g.
Total plasma protein g./100 c.c. plasma	6.83 g.	6.11 g.	5.52 g.	4.81 g.
Liver choline content mg./g. of fresh liver tissue	2.14 mg.	1.89 mg.	1.43 mg.	1.55 mg.

The total plasma protein concentration shows a definite decline as the daily intake of casein is reduced and the liver choline content also shows a similar fall.

Histology

On microscopical examination, the liver in animals which received 1.2 and 0.6 g. of casein per rat per day showed no pathological changes. Animals which received 0.4 and 0.2 g. of casein per rat per day, on the other hand, showed slight fatty change of the hepatic parenchyma around the central veins. But, in marked contrast to the animals in the low protein groups which were deprived of vitamins of B₂ complex, none of the animals in this group showed marked fatty change in the hepatic parenchyma around the central veins, accumulation of ceroid pigment or diffuse hepatic fibrosis.

3. Clinical Experiments

In addition to our experimental work, clinical treatment of decompensated portal cirrhosis cases with high protein, high caloric diets with vitamin supplements formed an important part of our studies on the 'cirrhosis of the liver' and this investigation was carried out in collaboration with Dr. N. J. Modi, M.B.B.S., M.R.C.P. (Lond.), in the medical unit of the Goculdas Tejpal Hospital, Bombay.

Twenty patients were treated with high protein diets which included skimmed milk powder, egg protein, fresh milk and casein hydrolysates. Vitamin supplements were given in the form of yeast tablets with injections of vitamin B₂ complex and liver extract in some cases. The majority of the patients come from the poorer classes and their dietary histories revealed gross deficiency in calories, protein and vitamin intake. Ten out of the twenty cases gave history of having had attacks of malaria. Nine cases were addicted to alcohol. Past

history of dysentery was present in four cases and jaundice in only two cases.

The presenting symptom of all patients was enlargement of abdomen, varying in duration from 15 days to two years. All the cases showed evidence of fluid in the abdomen. Spleen was enlarged in eight cases and liver was found enlarged in four cases only. The level of serum proteins was estimated before, during and after treatment as this afforded an objective evidence of the course of the disease. Total protein, albumin, globulin and euglobulin content of blood serum was estimated.

A common observation in all the patients before treatment was the fall in albumin and rise in globulin fraction of the serum proteins thus showing an altered albumin/globulin ratio from the normal. In the globulin fraction, the Euglobulin showed marked increase.

The period of observation during treatment was on an average 5 to 6 months. The results of therapy at the hospital have

been quite encouraging. Patients treated with high protein diet showed definite clinical improvement. Ascites, edema and other manifestations of the disease disappeared in many instances. Clinical improvement was attended with a change in the serum protein level towards normal values.

A detailed account of these investigations will be shortly published elsewhere.

We wish to thank Major-General Sir Sahib Singh Sokhey, Kt., Director, Haffkine Institute, Bombay, for his constant encouragement and keen interest in this work.

1. Radhakrishna Rao, M. V., "Monograph on Cirrhosis of the Liver in Northern Circars—South India," *J. Ind. Med. Assoc.* (Dec. 1936; Jan.—July 1937). 2. Himsworth, H. P., and Glynn, L. E., *Clin. Sc.*, 1944, 5, 93-123 (1944).

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ORGANOLITES IN INDUSTRY

ADDRESSING the members of the Research Club, Kanpur, Dr. M. S. Bhatnagar said that Way first of all discovered the phenomenon of ion-exchange in inorganic substances like clay, silica, etc. Barrell gave the name of organolites to ion-exchanges got from synthetic resins. In 1935, Adama and Holmes working under G. T. Horgan, indicated the possibilities of using these synthetic resins for ion-exchange purposes. He prepared some cation and anion exchange resins from tannin barks and aromatic amines respectively. He found out that monohydric phenols cannot be used for the above purposes, but later on Sir Bhatnagar and his co-workers showed that ion-exchange resins can also be made from ordinary carboxylic acid. These resins are of two types: (a) Cation exchange and (b) Anion exchange. Further, there are two types of cation exchangers—(i) having a strong acidic group like SO_3 and (ii) having a

weak acidic group like carboxylic. The first one can be used for removing the cations from salts of both weak and strong acids while the second is useful only in removing the cations from salts of weak acids. These resins have as many applications as the types they can be made.

Continuing, Dr. Bhatnagar said that the cation exchangers are used for softening water and removing inorganic substances from sugar juice, apple and citrus fruit juice, dilute solutions of gelatin, etc. These juices are first passed through a cation exchanger which removes the metallic ion and later on, an anion exchanger removes the acid. Thus hard water can be very easily softened and also citric and lactic acids can be recovered. The most important contribution of these resins is in the purification of antibiotics like penicillin from moulds and in purification of alkaloids.

HAFFKINE INSTITUTE OF PREVENTIVE MEDICINE, BOMBAY

THE Report for the period 1944-46 is a record of all-round activity. Owing to the impact of war the Institute had to assume various functions which were not in its usual programme. Substantial contribution to medical research in the direction of improvement in prophylactic vaccine, antitoxin serum, antivenene, etc., has been made during the period under report. The scope and activities of the department of chemotherapy was considerably expanded. The Report has been divided into Part I—General and Part II—Research. Among the essential features of the report a few may be cited.

1. *Cholera Vaccine*—Casein hydrolysate direct cholera vaccine was developed during the period. This vaccine was found to possess ten times more protective value than the standard agar grown vaccine. A new method for assessing active immunity in cholera was developed using white mice as test animal. When prepared under controlled digestion process the Muller and Johnson's casein hydrolysate medium is protein free and the plague vaccine made in this medium was found to retain its protective power even when stored at 37° C. for 18 months. This vaccine is much less toxic to mice than the previous vaccine.

2. *Serum*—Anti-human horse serum was found to prevent allergic and anaphylactic reactions. This was demonstrated in field trials on plague patients treated with anti-plague serum to which 5 gm. of dried

anti-human serum was added to 1 litre of anti-plague horse serum.

In the preparation of antivenene a method was developed by which a highly potent polyvalent serum against all the four kinds of snake venom of cobra, krait, Russell's viper and Echis was obtained by injecting horses with a mixture of all the four venoms. The technique of lyophilising has been utilised in the preservation of antitoxin and antisnake venom sera. Now antivenene is issued in dried form in which it can be stored in any rural dispensary so that in case of emergency it can be made readily available and can be used for injection by dissolving in sterile distilled water. This is a remarkable achievement for this country where snake bite is so common and the absence of properly equipped storage condition made it difficult or impossible to make use of the benefit of the antivenene in most cases.

3. *Chemotherapy*—Remarkable success has been obtained in reducing plague mortality to a negligible level by the use of streptomycin, sulpha-diazene and sulpha merazine and sulpha methazine. Pilot plant production of the sulpha drugs has already been established. The Report also contains various other important and instructive information for those interested in medical research.

The authorities of the Institute deserve praise for such a valuable record of work.
5th March 1949. K. P. MENON.

INDIAN JOURNAL OF HELMINTHOLOGY

WE are very happy to welcome the *Indian Journal of Helminthology* being the official organ of the Helminthological Society of India.

While some may contend that there are far too many biological journals in India for all of which the right type of material is scarcely available, we feel that the want of a journal on applied zoology was long felt and the *Indian Journal of Helminthology* gives a large fillip to helminthological workers in India who had to seek hospitality elsewhere for their research publications. In the first issue (October 1948),

which has just reached us, all the articles (except one) are from the Lucknow School of Helminthology working under the inspiring guidance of its chief, Prof. G. S. Thapar who is also the Editor of the Journal.

The articles are of a high standard and like its contemporaries in other branches of science, the get-up of the journal is very good.

The journal is published biennially and each issue is priced Rs. 5.

We wish it all success.

A RE-EXAMINATION OF SOME ASPECTS OF PURANAS AND ARCHAEOANS OF SOUTH INDIA*

PIONEER geologists such as C. Æ. Oldham, Robert Bruce Foote, William King, C. S. Middlemiss and T. H. Holland traversed large tracts of Peninsular India and carried out reconnaissance survey and have given us the results of their observation in several publications of the Geological Survey of India which constitute classics in the geological literature of Peninsular India. Considering the undeveloped nature of the country, the absence of communications and facilities for work in those times, we cannot but marvel at the valuable contribution of these great pioneers in the realm of field geology. Recent work has however necessitated our re-examining some of their conclusions. In putting forward views divergent from those of the early pioneers like King or Foote or Holland, I wish to state that no disparagement is intended to their classical contributions.

THE PURANA GROUP: BHIMA SERIES—A RECLASSIFICATION

In his Memoir on the South Maharatta country, Bruce Foote recognised a group of unmetamorphosed shales and limestones in parts of Gulbarga District in Hyderabad State and in the contiguous parts of Bijapur District, Bombay Presidency, occurring in the Bhima-Kistna doab and King gave them the name "Bhima Series" and correlated them on lithological grounds to the Kurnool formations, from which they are separated by a vast stretch of Archæan rocks. He divided the Bhimas into a lower series consisting of conglomerates, sandstones, and shales, and an upper series, of limestones.

During a revision survey of Gulbarga District between years 1935 and 1941, an area of over 2,000 square miles of the Bhima Series was covered. One of the important results of this revision work is the recognition of a threefold division of the Bhima Series as against the twofold division given by Bruce Foote. The Lower Bhima Series consisting of basal conglomerates, sandstones, and shales, are 250 feet in thickness, the middle Bhima Series

comprising of limestones, accounting for 550 feet, and the Upper Bhima Series, made up of local sandstones, shales, and flaggy limestones have a thickness of 325 feet.

Two dolerite dykes cut through the limestones of the Lower and Middle Bhima Series, and run for some miles. This observation gains importance from the fact that Sir L. L. Fermor distinguished only two groups of basic dykes prior to the Deccan Traps, one contemporaneous with the Dharwar system and the other younger than the Cheyair stage of the Cuddapahs.

THE PALNADS

The age of the Palnad Series north and south of Kistna in the districts of Guntur in Madras Province, and Nalgonda in the Hyderabad State, was a matter of controversy between two of the pioneers of South Indian Geology, namely, King, and Bruce Foote. King was of the opinion that they were of Kurnool age, whereas Foote was inclined to the view that they might be classified with the Kistna beds which are the uppermost of the Cuddapah system. The reason for this controversy was the absence of a recognisable unconformity between the Kistnas and Palnads in the area covered by them.

We have adduced evidence on structural, lithological and chemical grounds, to show that there is a clear disconformity between the Cuddapahs and the Palnads in the taluks of Narasaraopet, Vinukonda and Guruzala, in Guntur District. Lithologically and chemically these show the closest similarity to the Narji limestones, which are of undoubted Kurnool age, to the Bhima limestones and to the Sullavoi limestones, which have been correlated to the Kurnools. In contrast to the Palnad limestones, the Cuddapah limestones generally give lower values for calcium carbonate, and greater values for magnesium carbonate.

There does not seem to be any formidable difficulty from the available field and laboratory evidence in considering the Palnads as homotaxial with the Kurnools and later than the uppermost Cuddapah beds and separated from the latter by a recognisable disconformity. Much work, however, remains to be done systematically in this area.

* Abstract of the Presidential Address delivered by Prof. C. Mahadevan, to the Geology and Geography Section of the Indian Science Congress, Allahabad, Jan, 1949.

THE PAKHALS

King, in his Memoir on the Pranhita-Godavari valley, recognised certain sedimentary formations in the neighbourhood of Pakhal village adjacent to a lake of the same name, and at Sullavoi, further north-west. King correlated the Pakhals with the Cuddapah group and the Sullavois with the Kurnool series. He recognises, however, that the correlation of the subdivision of rocks with the groups of Cuddapah series has not been possible.

In the years 1941-44 I had the opportunity of mapping major parts of Sheets 65 C/NW and C/NE and studying in detail the geology of the area.

I venture to suggest that the Pakhals are not homotaxial with Cuddapahs but correspond to the Middle Dharwars comparable to the Gangpur series of Dr. M. S. Krishnan for the following reasons :

1. Nowhere have we seen an unconformity between the Pakhals and the granites.

2. The Pakhals dip at high angles and show folding and pitching and the sediments have been metamorphosed to micaceous garnetiferous phyllites and mica schists with garnets, staurolites, andalusites, chiastolites and kyanites, garnetiferous and micaceous quartzites, tremolite-actinolite schists and marbles, a feature never known to occur in the Cuddapahs.

3. Lithologically, the Pakhals are most dissimilar to the Cuddapahs and afford no comparable correlation, as admitted even by King.

4. The granites are distinctly intrusive into the Pakhals, producing widespread contact effects, whereas the Cuddapahs rest unconformably over the granites, as is evident all along the junction.

ARE THE PAKHALS HOMOTAXIAL WITH THE KHONDALITES ?

In the Pakhals we meet with micaceous schists, garnetiferous phyllites, mica-garnet-staurolite schists, mica-garnet andalusite schists, mica-garnet-kyanite schist, carbonaceous phyllites and marbles. It appears that the same type of rocks when subjected to higher grade of metamorphism give rise to rock-formations extraordinarily similar to the khondalites. We are probably, therefore, justified in considering that the Pakhals are only a less metamorphosed facies of the Khondalites and that both belong to the middle Dharwars.

AGE OF THE KALADGIS

The Kaladgi Series occurring in Bombay Presidency were considered by Bruce Foote to be homotaxial with Cuddapahs mostly on lithological grounds. Recently Dr. L. A. N. Iyer from the Geological Survey of India in his interesting paper on the Geology of South Ratnagiri has noted clear evidence of the intrusion of granites, basic and ultrabasic rocks into the Kaladgis. Just as in the case of Pakhals it appears that the Kala igis, at any rate a major part of them, are of Dharwar age.

ARCHÆANS: KHONDALITES AND ASSOCIATED ROCKS

Dr. M. S. Krishnan has drawn attention to the much needed correlation of the various types of garnetiferous paragneisses of South India and has suggested that the term khondalite originally applied by T. L. Walker to these rocks in the Kalahandi State may be extended to the Bezvada gneisses of Foote and King, the Kailasa gneisses and the Vizianagaram gneiss of King as also the garnetiferous gneisses generally associated with the charnockites in the southern districts of Madras Presidency. The Schistose series of Gudur area consist of garnet-mica schists, with kyanite and staurolite. The Nellore mica belt is on the same strike as the khondalites and there is every reason to suppose that it is merely the continuation of the khondalite zone.

SUMMARY

An effort has been made in this address to show that the Bhimas may be divided into three groups, namely, Lower, Middle and Upper, that basic igneous activity continued upto the Kurnool stage in South India; that the Palnads are comparable to the Kurnools in stratigraphic position and that the Pakhals and Kaladgis are not of Cuddapah but of Dharwarian age. The khondalites are only a more metamorphosed phase of these Pakhals.

As regards the khondalites, an attempt has been made to correlate the paragneisses of South India with the khondalite group. That some of the Dharwars of South India such as those of Nellore are merely the schistose facies of the khondalites has also been shown.

A new vista of economic possibility is opened up as a result of this attempted classification of the stratigraphy of some of the members of the Puranas and Archæans in Peninsular India.

SOIL-BORNE PLANT DISEASES AND THEIR CONTROL*

ECONOMIC stability and prosperity of our newly constituted motherland is closely linked up with scientific growth and development of agriculture, and we in this Section have to play an important role in the work connected with it. It is the national duty of those concerned with it to strive their best to promote food production.

In India yields are lower than in other countries even in normal times and are further depressed by diseases. Losses on this account have been estimated in the neighbourhood of 10 per cent. which can be averted by application of suitable control measures. A considerable portion of such heavy losses is due to the soil-borne pathogens and, in order to prevent these losses, it is essential to obtain full knowledge about the life-history of the pathogens and their behaviour under controlled conditions, so that they may be attacked at the most susceptible stage of their life-cycles. The activity of a soil-borne pathogen forms only a part of the highly complex associations of living organisms most of which are non-pathogenic. A striking example is that of *Fusarium udum*, the pigeon-pea wilt organism, the growth of which has been found to be adversely affected by *Bacillus subtilis* commonly present in the soil. The population of micro-organisms in the soil attains a state of equilibrium by the continued prevalence of a uniform set of conditions and even a slight variation in these conditions may upset this balance, and affect the number and types of soil microflora. We may, therefore, by adjusting the prevailing agricultural practices be able to change the microbial setup in such a way as to adversely affect the parasitic activity of an organism in the soil.

It is, however, essential to have a sound knowledge of the interrelationship of the individual factors and the pathogen. The conditions under which different soil-borne pathogens flourish are fairly wide. Many of the organisms are highly aerobic and therefore flourish in light soils, but there

are others which flourish in comparatively heavy soils. Such parasitic fungi as *Fusaria* responsible for wilt diseases flourish at comparatively high soil temperatures, but there are others like *Phytophthora infestans* which are restricted to low temperatures and are extremely sensitive to fluctuations in temperature. A reasonably high moisture content is necessary for the development of certain parasitic fungi, but again there are some the spread of which is adversely affected by excessive soil moisture. Reaction of the soil also considerably affects the parasitic activity of a fungus. While diseases such as wilt of cotton and club-root of clovers are favoured by acidity, others like the flag-smut of wheat develop in alkaline soils. Available nutrition in the soil also has a profound effect on the existence and activities of a pathogen. Application of nitrogenous fertilisers has been found to increase the virulence of a disease and the use of phosphatic fertilisers to enhance the resistance of the host. Evidence on this aspect of the question as well as on the effects of other soil conditions on soil pathogen is, in general, not conclusive as contradictory results have been reported very frequently.

Among the Control Measures devised to prevent losses caused by soil-borne pathogens, there is no doubt that the most perfect method is the production and large-scale distribution of seeds of resistant varieties in a country like India where the growers are comparatively poor and cannot resort to expensive methods of control (the efficiency of which is often doubtful). The production of resistant varieties is a long-drawn process and is further complicated by the existence or appearance of physiologic races of the pathogens. Rotation of crops is often beneficial, as it starves out the fungus which requires a suitable host for its existence, but it is to be remembered that even long-term rotations have proved ineffective in certain cases. Sterilization of soil by heat and chemicals is often recommended for the control of soil-borne diseases. Sterilization of soil by heat is not practicable on a large scale and, wherever carried out, it has been frequently found that if the pathogen is introduced afresh from an outside source, it does greater damage than in unsterilized soil which contains generally a large saprophytic

* Summary of the Presidential Address of Dr. R. S. Vasudeva, delivered before the Section of Agriculture, during the 36th session of the Indian Science Congress, held at Allahabad, Jan. 1949.

flora. Sterilization by chemicals has not been found to be effective on a field scale, as a good penetration into the soil is generally not obtained. Biological control offers a good means of preventing soil-borne diseases. Starving out the pathogen or eliminating it altogether by enhancing the antagonistic activities of the non-pathogenic micro-organisms has been found to be possible by modifications of cultural practices or addition of certain manures as in the case of "Take-all" of wheat and potato scab. Field sanitation is another control measure which is often neglected to the detriment of the cultivator. Certain diseases like wilts are known to render fields unfit for cultivation and others like gram-blight perennate on crop refuse in the field. Debris from an infected crop should, therefore, be destroyed and not allowed to disperse. Rogueing diseased plants in the case of annual crops has not always been found to be beneficial, but has given good results in Plantations. Keeping the land fallow has also given good results in certain cases.

Amendment of soil conditions with a view to excrete unfavourable conditions for the pathogens has been tried with considerable success. Two striking examples are afforded by "Take-all" disease of cereals and root-rot of cotton. In the former case trefoil and Italian ryegrass are intercropped with barley. After barley is harvested in autumn the seed-mixture grows actively and it is harvested in early winter and ploughed in. During its period of growth the mixture utilizes nitrogen essential for the "Take-all"

organism and thus virtually starves it out. If the mixture is ploughed in, it gradually decomposes and liberates nitrogen for the next crop of barley. In the case of root-rot of cotton in the Punjab reduction in field temperature has been obtained by intercropping cotton with *moth* to control the disease. Changing the date of sowing has also proved very effective in controlling this disease. Adjustment of soil reaction by using such chemical substances as sulphur and lime has given successful results as in the case of potato-scab and club-root of clovers, but such methods are generally not practicable on account of the cost involved. Adjusting the soil moisture by giving proper attention to drainage and changing the depth of sowing has in some cases yielded good results, but cannot always be relied upon.

From what has been said about the behaviour of pathogens and control measures it is obvious that, while investigations carried out have cleared many obscure features, there are still more complex ones that require to be elucidated by intensive research involving radical changes in technique and methods of approach. It will be noticed that every one of the farm or garden crops is exposed to attack of some one or other types of soil fungi. The subject of soil pathology has gained importance during recent years. Having attracted the attention of pathologists it offers hopeful signs of solving the diverse pathological problems. For a proper study of these problems, team work of pathologists, soil-chemists, crop-physiologists, geneticists, and agronomists is what is imperatively needed.

SOME ASPECTS OF TUBERCULOSIS IN INDIA AND MEASURES FOR ITS CONTROL*

THE question of Tuberculosis is of vital importance to India at the moment; the defences of the cities against a disease like tuberculosis are yet weak and poor and the author insists that everything should be done to strengthen the defences.

* Abstract of Presidential Address delivered by Dr. M. B. Soparkar, before the Section of Medical and Veterinary Sciences, 36th Indian Science Congress, Allahabad, 1949.

In his Presidential Address, Dr. Soparkar, who has spent more than twenty-five years in the study of the various aspects of the disease both in man and animals, firstly deals with those aspects of tuberculosis which affect animals particularly cattle, because of its intrinsic importance from the agricultural and veterinary standpoint. The second part deals with the disease in relation to its control and eradication in India as it affects human beings.

Dealing with the tuberculosis among cattle, the author says that as a result of extensive survey it is found that the incidence of infection detected in India is about equal to that found in European countries where bovine tuberculosis is known to be prevalent and even exceeds those in some parts of Europe and America. The author says that if the incidence is based upon results of tuberculin test, it would probably reveal still higher incidence. The strains of tubercle bacilli isolated from cattle in India were found to be as virulent as those of European origin. The Indian cattle as a rule are not known to be infected under natural condition with tubercle bacilli of human type. The characters of the strains isolated were found to be of bovine type except in some isolated cases where the organisms isolated were found to be a mixture of bovine and avian types.

Although cattle are not as susceptible to infection with human type as they are with bovine type, yet they are known to be capable of harbouring this infection and of excreting these bacilli in milk without any gross lesion in the udder. This infection, therefore, if found on investigation to be prevalent among Indian cattle would constitute another source of danger to public health.

Besides cattle, several other species of animals suffer from natural tuberculosis. In the Zoological Gardens in Bombay the author found a large number of animals of different species including Llama, spotted deer, Nilgai, Sambar, antelope, Arabian gazelle, Malayan tapir, suffering from tuberculosis. In view of these findings and chronic course of the disease there is an obvious danger of infection to those who visit the gardens.

Taking up next the subject of the surgical form of tuberculosis the address refers to the meeting of the Second All-India Veterinary Conference held at Calcutta (1923). Major-General (then Colonel) Hutchison stated at the Conference that the so-called surgical form of tuberculosis such as bone and joint tuberculosis, glandular tuberculosis and other closed type of tuberculosis occur in India in the same proportion as in Western Countries and he laid stress upon the necessity of investigating the organism responsible for this form of human tuberculosis in India. The investigations carried out by Dr. Soparkar and

others have shown that this type of disease is caused in India except in rare instances—mainly by the human type of tubercle bacilli. These and similar findings would appear to show that the bovine bacillus does not play an important role in the causation of human tuberculosis in India in spite of the high incidence now recorded of the disease among cattle. This is mainly perhaps because of the almost universal practice of boiling milk. Nevertheless a potential danger would remain.

Referring to experiments on immunisation against John's disease caused by an acid-fast bacillus closely allied to tubercle bacillus, the address says that intravenous inoculation of cattle with living avian tubercle bacilli has been used for the purpose of prevention. The results of Dr. Soparkar's experiments in this connection suggest the possibility of averting the fatal effects in cattle following upon intravenous inoculation of avian tubercle bacilli, by previous treatment of the animals by subcutaneous method, thus rendering safe the method of preventive inoculation of cattle against John's disease by the application of living avian tubercle bacilli.

Discussing the nature of allergic reaction in tuberculosis the paper states that results of experiments have demonstrated the presence of a toxic product and afford a direct experimental proof in support of the hypothesis that in apparently normal skin of tuberculous animals certain substances are present which, when brought in contact with tuberculin, render it toxic so that an inflammatory reaction is produced.

As regards the existence of a filterable form of tubercle bacillus, the author carried out several experiments, and obtained evidence of the existence of a filterable form, probably representing a stage in the evolutionary cycle of the organism.

Turning to the immediate practical problem of the control of tuberculosis in man, the author first deals with the available data regarding the prevalence of tuberculosis in India. He then goes on to discuss the expenditure involved in providing adequate number of beds for the isolation and treatment and after-care of cases, a means adopted in Western countries where the control measure has made good progress. Such measure in India would involve an enormous sum of money which the country under the present circum-

stances can hardly afford. The whole scheme cannot be implemented at once even if funds are available and it will take time before the disease can be controlled to any appreciable degree by adopting this measure. In the meanwhile something must be done and the author suggests that the only solution to the problem appears to be mass immunisation. The method which has been of late widely adopted is preventive vaccination with B.C.G. Experience of over ten million vaccination with B.C.G. has demonstrated the safety and harmlessness of the measure and the protection it affords. After discussing protective value of B.C.G. vaccination and the effect of this vaccination on general infant mortality, the author points out that the

Ministry of Health, Government of India, after careful consideration, have come to the conclusion that mass vaccination with B.C.G. will be a cheap and effective method of control. It has been decided to introduce this method at first on a limited scale in a few large centres in the country under the supervision and control of the Central Government.

In conclusion, the author stresses upon the need for further research in this direction and urges the authorities to launch a campaign for the mass vaccination with B.C.G. Given the will and the drive, it will be possible, with proper organisation, the author remarks, to give protection to millions of the population and thus bring this disease under control. N. N. DE.

THE PLACE OF PHYSIOLOGY AMONGST THE MODERN SCIENCES AND THE IMPORTANCE OF ITS STUDY TO THE NATION*

DR. SARKAR in his Presidential Address has described Physiology as the study of the normal working of the delicately adjusted systems and of the various factors belonging both to the internal and the external environments, which influence and modify their activities. The importance of physiological knowledge for the health and welfare of individuals and the nation as a whole is universally recognised. Physiology therefore should be a special subject of study and research. Dr. Sarkar has indicated a few lines along which we should proceed to improve and develop the study of physiology and intensify research in the subject.

Discussing the claim of physiology for being considered as an independent science, the author says that as an independent subject of study, it rests on the tripod, Morphology, Physics and Chemistry. He emphasised that in our country Physiology has to be viewed and fostered as a fundamental subject of importance. It should be developed on proper lines like other important science subjects. It is true that the growth of physiology is inseparably connected with that of medicine. But physiology is not a branch of medicine though it forms one of its principal basic subjects.

And as such it forms the solid foundation on which the clinical knowledge is built up. Therefore, the systematic study of physiology should be continued with advantage during the subsequent years in the clinical classes and post-graduate studies in medicine.

Dr. Sarkar suggests that when there are plans for improvement of education for the proper training of high class scientists and technicians in this country, immediate steps should be taken for carefully preparing plans for the improvement of medical curriculum. All the outstanding results of modern progress should be included in the study and it is not a bad idea as Dr. Sarkar points out to provide additional course of study in physiology of a higher standard.

Acknowledging the importance of the study of physiology as advancing our knowledge regarding the working capacity of man under various conditions of stress and strain imposed by modern civilisation, the author says that proper arrangements should be made for training scientists in the theory and practice of some of the highly specialised technical branches of physiology. With this object in view it has to be decided whether physiology should find a place in School and College curriculum. The author sees no reason why elementary physiology should not be introduced in schools as a compulsory subject of study. It should also be included

* Abstract of Presidential Address delivered by Dr. B. B. Sarkar before the Section of Physiology, 36th Indian Science Congress, Allahabad, 1949.

in the graduation course and post-graduate study encouraged.

Dealing with researches in physiology Dr. Sarkar goes on to say that extensive research must be undertaken not only for the development of the subject but also for the solution of many urgent problems for the benefit of mankind. Researches in fundamental physiology are the bases on which Applied Physiology will grow and develop and the many problems on the applied side such as physiology of growth and development, physiology of reproduction, of regulation of body temperature, aviation physiology, physiological effect of radiation, industrial physiology, etc., call for immediate attention. Plans for future progress in all directions should be instituted so that posterity will benefit most from these investigations. Another problem which is very urgent is the solution of nutritional problem which is confronting people in every sphere of life all over India. It will be the duty of the

physiologists and the nutritionists to study the nutritional requirements of the people and the biological food values of available material and to devise a physiologically suitable diet from them.

The author concludes by saying that India will need a large number of well-trained physiologist to tackle her innumerable problems and the Department of Physiology will be required to supply these workers. This is only possible, the author points out, by treating physiology as an independent science subject of great importance. Dr. Sarkar appeals to all the physiologists to put their heads together, to prepare carefully plans for inaugurating and stimulating higher studies and extensive researches in physiology. He also appeals to the Government, the Universities and the learned scientific bodies to give their serious attention to this essential matter and help to develop this important science.

N. N. DE.

OBITUARY

JAMES HORNELL, 1865-1949

THE recent death of Dr. James Hornell in England has caused profound regret in India particularly among the fishery workers.

After a brief service in Ceylon in connection with investigations on Pearl Banks initiated by Professor W. A. Herdman, Hornell joined the Madras Fisheries Department as Marine Biologist in 1915. In 1918 he took over charge of the Directorate of Fisheries from Sir Frederick Nicholson. Though he could not put through many of his schemes on account of financial difficulties caused by the war of 1914-18, his regime was marked by conspicuous progress on all aspects of fisheries. Among some of the contributions of Hornell are the initiation of fisheries research, establishment of biological stations at West Hill, Krusadai and Ennore, a technological station at Tanur and of a fish cannery at Chaliyam, reorganisation of the chank fisheries, fish curing yards, the aquarium and the maintenance of fishery statistics

and the initiation of welfare work amongst fishermen such as general and technical education and co-operation. He retired in 1923 after a distinguished record of service.

From 1924 onwards he was engaged by the Colonial Office in England to study and reorganise fisheries in Palestine, Malta, West Africa and Fiji. He took an active part in a number of fisheries conferences and meetings including the Colonial Fisheries Conference held in England in 1946.

His contribution to the fishery literature is rich and varied. The *Madras Fisheries Bulletins* published by him are invaluable guides to fishery workers. His recent book "*Water Transport*" is a great contribution on the crafts of different parts of the world. The excellent pioneer work of Hornell in the field of fishery development and fishermen welfare will be long remembered in this country.

K. C.

LETTERS TO THE EDITOR

	PAGE		PAGE
On $\tau(n)$ Modulo 49—HANSRAJ GUPTA ..	119	Commercial D.D.T. as an Insecticide on Sugarcane Crop—K. L. KHANNA AND S. L. SHARMA ..	129
Harmonic Analysis and Experimental Data—A. ANANTHAPADMANABHA RAO ..	119	Nature of Bond in Ionic Crystals—S. K. KULKARNI JATKAR AND (MISS) S. B. KULKARNI ..	130
On the Investigation of π and μ Mesons—M. P. MURGAI ..	120	Ionic Character of Hydrogen and Alkali Halides—S. K. KULKARNI JATKAR, (MISS) S. B. KULKARNI AND S. N. GOPALASWAMY ..	131
The Geomagnetic Equator—K. S. RAJA RAO	121	Bond Energy and Ionic Character of Hydrogen and Alkali Halides—S. K. KULKARNI JATKAR AND (MISS) S. B. KULKARNI ..	131
Study of the Conditions of Precipitation of Cupric Hydroxide from Cupric Salts by Soluble Hydroxides—ARUN K. DEY ..	123	On Rapid Volumetric Methods for the Estimation of Silver, Barium and Strontium in Aqueous Solutions—ARUN K. DEY ..	132
Vanadimetry-Part II—G. GOPALA RAO AND V. BRAHMAJI RAO ..	124	An Unrecorded Insect Pest of the Cashew Tree (<i>Anacardium occidentale</i> , L.) in South India—TRUPAPUR A. DAVIS ..	133
A Study of <i>Cercaria Fraseri</i> Buckley, 1939 in <i>Mardas</i> —M. ANANTARAMAN AND G. BALASUBRAMANIAM ..	124	Phosphorus Oxychloride, A New Condensing Agent for the Chalkone Formation—G. N. VYAS AND N. M. SHAH ..	134
Life-History, Bionomics and Control of Sweet Potato Weevil— <i>Cylas formicarius</i> F. in Bombay Province—K. N. TREHAN AND S. R. BAGAL ..	126	On the Food of the Goonch <i>Bagarius Bagarius</i> (Ham.)—G. K. KURIYAN ..	134
Studies in the Storage of Gur—K. L. KHANNA AND A. S. CHACRAVARTI ..	127		
Crude Common Salt as a Fairly Good Source of Dietary Calcium in the Case of South Indians—M. N. MOORJANI AND V. SUBRAHMANYAN ..	128		

ON $\tau(n)$ MODULO 49

A CAREFUL study of my "Table of Values of $\tau(n)$ " for values of n up to 400, has led me to the

Conjecture: If p be a prime of the form $7q + r$, where $r = 3, 5$ or 6

then

$\tau(p)/7 \equiv r - 1 - [3/r] - 2q \pmod{7}$, where $\tau(n)$ is Ramanujan's function and $[x]$ denotes as usual the greatest integer in x . It may be noted that

Lehmer's Conjecture: If p_1 and p_2 be primes congruent modulo 49 and $\left(\frac{p_1}{7}\right) = -1$,

then $\tau(p_1^a) \equiv \tau(p_2^a) \pmod{49}$, $a \geq 1$, would follow readily from my conjecture and the well-known result

$\tau(p^m) = \tau(p) \tau(p^{m-1}) - p^{11} \tau(p^{m-2})$, $m \geq 2$.

Government College, HANSRAJ GUPTA.
Hoshiarpur,
January 5, 1949.

Gupta, H., "Table of Values of $\tau(n)$," *Proc. Nat. Inst. Sci., India*, 1947, **13**, 201-6. Lehmer's Conjecture was conveyed to me by R. P. Bambah in a recent letter.

HARMONIC ANALYSIS AND EXPERIMENTAL DATA

THE chief characteristics of yields of most of the perennial and tree crops in successive years are the presence of cyclic changes and trends, great variability in the yields of plants in the same year and the correlation between the yields of the plants in successive years. Such trends, cyclic changes, variability and correlation in the data are common in experimental data of some other branches of studies such as economics, biology, etc.

The characteristics mentioned above offer some difficulties in the study and interpretations of experimental data and in obtaining conclusive results from experiments. Inconsistent results are at times obtained by applying the usual methods of the analysis of variance for the data of individual years or experiments. Orthogonal polynomials have been frequently used to represent trends in the experimental data. But they are unlikely to be of much use in representing the nature of trends mentioned earlier.

One of the methods, which appears to be satisfactory, would be to represent the data by a multiple regression equation of the

type $y_t = bt + A \cos \frac{2\pi t}{T} + B \sin \frac{2\pi t}{T} + \text{constant}$,

where y_t = Yield for year t

b = linear regression coefficient

A and B = Fourier constants of the harmonic. Trends of higher order like parabolic etc., may also be represented by adding terms like $Ct^2 + dt^3$, etc., to the above equation.

This is illustrated by taking yield data of a perennial crop for 9 years, which exhibited certain definite trends, cyclic changes and random variations. Application of orthogonal polynomials gave the following analysis of variance.

Source of variation	d.f.	M.S.
Deviation from mean	8	2711
Linear regression	1	8874
Quadratic	1	523
Cubic	1	399
Quartic	1	622
Quintic	1	4608
Deviations	3	2221

These have removed a certain portion of the variation in the series, periodogram analysis with trial periods of 2, 3, 4 and 5 years showed that the energy of the third harmonic is maximum. This harmonic is

$$7.3 \cos \frac{2\pi t}{3} - 46.13 \sin \frac{2\pi t}{3}$$

Tests of significance as developed by Schuster modified by Walker and finally by Fisher can be applied. The extent to which the harmonic will represent the data may be examined by finding the reduction in the variance of the series after removal of the cyclic changes. Nearly 50% of the total variation can be explained by the harmonic.

The variation in yield can be more completely represented by the multiple regression equation

$$y = 10.68 - 3.37 \cos \frac{2\pi t}{3} - 39.96 \sin \frac{2\pi t}{3}$$

assuming that the cyclic changes are represented by a 3-year cycle. The analysis of variance would be

Source of variation	d.f.	M.S.
Regression	3	5326
Deviation	5	1140

The level of significance is near 5%. Thus, it would be possible in any experiment to examine and see if the regressions have been influenced by the treatments and if they differ from plot to plot. It is probable in some cases, the amplitude varies with time suggesting existence of damped harmonics.

More details on this will be appearing elsewhere.

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March 6, 1949.

ON THE INVESTIGATION OF π AND μ MESONS

EXPERIMENTS performed in Rome by Dr. Conversi, Pancini and Piccioni¹ on the interaction of mesons with matter have revealed the interesting fact that positive mesons decay in iron while the negative ones do not and are presumably captured by the nuclei. On the other hand, all the mesons—both positive and negative, decay in carbon; few could be captured by the nuclei. These results were later confirmed by Valley and Rossi (M.I.T.)² by much more elaborate apparatus incorporating both Wilson cloud-chamber and counters with delayed circuit.

This difficulty of weak interaction of the mesons with nuclei may be resolved if we assume that there are fundamentally two types of mesons with different masses.³ The lighter mesons which we observe at sea level are in fact produced as a result of the spontaneous decay of the heavier mesons that are formed at greater heights by proton primaries. This postulate appears to be confirmed by Powell and Ochiialini in Bristol⁴ by the photographic method. These workers call them μ and π mesons respectively. μ meson is the light meson of non-interacting type and π meson is the heavier interacting type. This hypothesis (of interacting and non-interacting types) refers to π^- and μ^- mesons, π^+ and μ^+ meeting always the same fate, i.e., suffering β decay.

The most probable height of formation of mesons was shown by Euler and Heisenberg⁵ while explaining absorption anomalies to be 16 km. above sea level. This has been confirmed by A. Duperier⁶ from the consideration of temperature effect.

Now if these are taken to be π mesons in the terminology of Powell and Occhialini, they will give birth to μ mesons during their flight. As the height of formation of mesons mentioned above is only the average value and there is a large layer of definite thickness in which mesons are formed, the limit up to which π mesons will retain their identity will, like the height of formation of π mesons, be not sharp and will have a finite thickness. The observations taken with increasing heights will, therefore, show relatively increasing number of π mesons (as shown by Powell's observations—this increase is due to the fact that at lower heights some of the π mesons have decayed into μ mesons, and also due to the increasing number of the primary radiation responsible for the production of π mesons), till we reach a limit where there will be no μ and only π mesons. In order to determine this height photographic method is not so suitable, as high mountain peaks with regularly increasing heights will have to be selected, in order to give long exposures to the plates. As an alternative, Dr. Conversi's apparatus with iron plates magnetised to concentrate negative mesons could be sent to greater heights. The height at which maximum interaction, indicated by a minimum number of decay electrons recorded in this apparatus, can be taken to be height of formation of μ mesons. Besides verifying the hypothesis of interacting and non-interacting types of mesons, it will give the thickness of the layer of formation of mesons.

Observations at sea level with Dr. Conversi's apparatus do not present any difficulty due to the soft component, as cosmic rays at sea level consist mostly of mesons. At greater heights some device of cutting away the soft component will have to be incorporated along with the above apparatus, in order to work with only mesons and to have unambiguous results. If the usual absorbing screens of lead are used, the amount of lead required may become prohibitive for observations at greater heights. We may, instead, have Bhabha's⁷⁻⁸ device of cutting away the soft component by splitting a very much less thickness of absorbing plate into two appropriate parts in the ratio of approximately 1:4. The thinner one, which corresponds to the thickness for the maximum of the Rossi curve, is used to produce

showers and thicker one to absorb the shower particles.

The writer wishes to express his thanks to Dr. R. C. Majumdar, Head of the Physics Department, Delhi University, Delhi, for the useful discussion on the subject.

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East Punjab University,
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March 5, 1949.

1. Conversi, Pancini, and Piccioni, *Phys. Rev.*, 1947, **71**, 209. 2. Valley G. F., *Ibid.*, 1947, **72**, 772. 3. Marshak, R. E., and Bethe, H. A., *Ibid.*, 1947, **72**, 506. 4. Powell and Occhialini, *Nature*, 1947, **160**, 453; *Ibid.*, 1947, **160**, 486. 5. Euler and Heisenberg, *Erg. Exakt. Naturwiss.*, 1938, **17**, 1. 6. Duperier, A., *Nature*, 1948, **161**, 645. 7. Bhabha, H. J., *Ind. Acad. of Sci. Proc.*, 1944, **19A**, 23. 8. Chandrasekhar, S. V. Aiyar, *Ibid.*, 1944, **19A**, 177.

THE GEOMAGNETIC EQUATOR

RECENT literature on the subject of terrestrial magnetism reveals that there is some confusion in the understanding of the term "Magnetic Equator", as it can be considered from two points of view—first from a knowledge of the dip angles (this being zero on the magnetic equator); and second from calculations based on the assumption that the earth's magnetic field is best represented by a small but powerful magnetic dipole at the geometrical centre of the earth. The latitudes determined by measurements of dip angles are designated "Magnetic Latitudes" and those calculated on the basis of the dipole theory are called "Geomagnetic Latitudes". Many workers seem to think that the two are identical while some make this distinction.

The measurements of polarisation of radio waves carried out at Huancayo where dip is $2^{\circ} 10'$ S, by Wells and Berkner¹ show that the ordinary and extraordinary rays are plane polarised as demanded by theory. This result leads to the view that it is the geomagnetic equator which counts and not the magnetic equator, so far as ionospheric work is concerned.

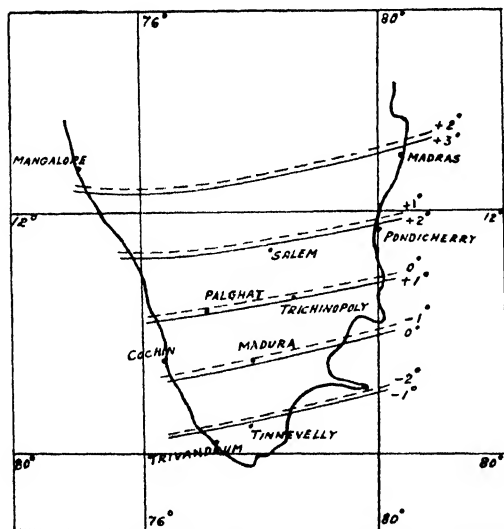
Appleton² first showed that for noon equinox conditions F_2 critical frequencies plotted against dip angles give symmetrical curves about the magnetic equator

with maxima at 28° N. and S. Appleton³ and later, Liang⁴ have replotted the F_2 ionisation densities against geomagnetic latitudes in place of magnetic latitudes. From these curves it can be safely concluded that it is more reasonable to use geomagnetic latitudes rather than the magnetic latitudes for the determination of the geomagnetic control over the ionosphere.

The apparent divergence between the magnetic and geomagnetic latitudes may be explained as follows. The geomagnetic potential V is made up of two parts V_e and V_i ,

$$V = V_e + V_i,$$

where V_e and V_i are parts of external and internal origin respectively. Bauer⁵ in his spherical harmonic analysis of the earth's field has shown that the field of internal origin forms 94% of the total field; the field of external origin being 3% and a non-potential part N due to earth air currents being 3%. The measurement of inclination is governed by local conditions and it represents the entire field while the dipole theory takes into account only the 94% of the total field. Although the divergence between the magnetic and geomagnetic latitudes is not much, it is there in principle and has to be considered.



A precise knowledge of the geomagnetic equator is hence necessary for those engaged in work on ionosphere, cosmic radiation and geophysical problems. To suit their needs McNish⁶ has published

nomographs from which the geomagnetic co-ordinates can be read off for any terrestrial point. The geomagnetic co-ordinates of any place can be calculated from the following equations:—

$$\begin{aligned}\tan x &= \cos(\lambda - \lambda_0) \cot \phi \\ \tan \Lambda &= -\tan(\lambda - \lambda_0) \sin x \sec(x + \phi_0) \\ \tan \Phi &= -\cos \Lambda \tan(n + \phi_0)\end{aligned}$$

where λ_0, ϕ_0 are the co-ordinates of the geomagnetic pole; λ, ϕ are the geographical co-ordinates of the place and are Λ, Φ the geomagnetic co-ordinates of the place. x is the auxiliary angle. These calculations have been performed on the assumption that the earth's magnetic field is represented by a dipole at the geometric centre of the earth.

Later, it⁷ has been shown that a still closer approximation to the earth's magnetic field is given by assuming it to be due to a dipole displaced 342 km. from the earth's centre towards a point in longitude 162° E. and latitude 6°·5 N., with its axis parallel to the line through the centre of the earth and the geomagnetic pole. Bartels has shown that the eccentric dipole gives a truer picture of the observed field than the centred dipole, especially in the equatorial region.

According to Vallarta⁸ this asymmetry in the magnetic field is fully competent to account for the observations of clay, Alfven, Milikan and Neher on cosmic radiation. Also Heisenberg⁹ has clearly stated that the magnetic centre does not coincide with the earth's centre.

The author has calculated the geomagnetic latitudes for about 50 places in South India, both for the centred and the eccentric dipole, using the equations given above. It was found from the analysis of the 1945 data that the co-ordinates of the geomagnetic North Pole are 78°·7 N. and 289°·9 E. in place of the earlier values of 78°·5 N. and 291°·0 E. The latest figures have been used in the present calculations; for the eccentric dipole the co-ordinates of the geomagnetic North Pole are 80°·1 N. and 277°·3 E.

The geomagnetic latitudes have been drawn at intervals of 1° (unbroken lines refer to centred dipole and the broken lines refer to eccentric dipole) in the map given in the preceding column.

The geomagnetic equator for the eccentric dipole agrees with Vallarta's results, and it is suggested that the eccentric dipole

field is to be taken into account when geomagnetic latitudes are required for work in the Indian Reigion.

The author is indebted to Dr. A. K. Das, Director, for his helpful criticism.

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February 12, 1949.

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STUDY OF THE CONDITIONS OF PRECIPITATION OF CUPRIC HYDRO- XIDE FROM CUPRIC SALTS BY SOLUBLE HYDROXIDES

Part II. Role of Hydration in Determining the Chemical Character of the Hydrated Oxide

IN Part I of the series,¹ we have determined the composition of the precipitates obtained by the interaction of cupric sulphate and sodium hydroxide in different proportions. It has been observed that the association of sulphate with the precipitate varies remarkably with the concentration of alkali used. The precipitate of hydrated cupric oxide has a tendency to retain more of sulphate in the adsorbed state when the amount of alkali used is less than the theoretically equivalent quantity. An account of the results is presented in the following table.

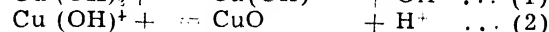
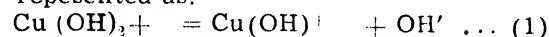
TABLE I

Concentration of cupric sulphate = 4.805
mgM. in 10 c.c. of the mixture
Temperature 30° C.

Alkali added in mgM.	Composition of the precipitate
9.833	CuO
9.636	59 CuO, SO ₃
9.439	47 CuO, SO ₃
9.243	24 CuO, SO ₃
9.046	16 CuO, SO ₃
8.849	12 CuO, SO ₃
8.653	9.6 CuO, SO ₃
8.456	7.3 CuO, SO ₃

It has been observed that besides the variation in the physical character of the

precipitate, the solubility of the precipitate in ammonia solution also changes remarkably. A sample precipitated using an excess of sodium hydroxide is totally insoluble in ammonia solution. The formation of cuprammonium complexes from the oxide seems to be determined by the sulphate present in it and also by the amphoteric nature² of the hydrated oxide. The dissociation of cupric hydroxide can be represented as:



In equation (1) the basic character of the oxide is predominant, as the liberated OH⁺ seeks protons, i.e., H⁺. In equation (2) Cu⁺(OH)⁺ behaves as a proton donor, thus leading to the formation of water as denoted by equation (3). Thus the CuO left will be chemically inert being produced by the neutralisation of the acidic and the basic properties of cupric hydroxide. A similar phenomenon has been reported by Dey and Ghosh,³ who suggested the same mechanism in hydrated ferric oxide to explain the growing insolubility of the oxide with age.

The amount of water associated with cupric oxide, when precipitated with different quantities of alkali has been determined. Two samples of hydrated cupric oxide using different quantities of alkali have been prepared. Water associated with the oxide is recorded in the table below:

TABLE II
Precipitations carried out at 30° C.

Ratio of copper to alkali	Composition of the precipitate
1 : 2.00	3.09 CuO, H ₂ O
1 : 2.10	5.74 CuO, H ₂ O

It is thus seen that the quantity of alkali employed for precipitation has an appreciable influence on the hydration of the precipitate. Samples with lower concentrations of alkali were not studied as they were found to be contaminated with large amounts of sulphate. It was further observed that ageing for a month had no perceptible effect on the hydration of cupric oxide.

It is therefore obvious that besides the variance in the quantity of sulphate associated with cupric oxide, hydration of the

oxide decreases with an increase in the quantity of alkali used for precipitation. This hydration ultimately affects the chemical properties of the oxide.

Further work on hydroxides is in progress, and the results, it is hoped, will throw considerable light on such phenomena.

The author thanks Dr. S. Ghosh of the University of Allahabad for his kind interest.

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VANADAMETRY—PART II

Volumetric Estimation of Ferrocyanide Ion by Sodium Vanadate

FERROCYANIDE ion is oxidised in acid solutions readily to ferricyanide ion by a number of reagents, e.g., hydrogen peroxide, potassium permanganate, dichromate, chlorate, bromate, iodate, chlorine, bromine, iodine, ceric sulphate, etc. Many years ago De Haen¹ proposed the estimation of ferrocyanide by titration with potassium permanganate. Muller and Lauterbach² adopted the same reaction for electrometric titration. Kolthoff³ proposed an iodimetric method based on the reaction between ferrocyanide and iodine in neutral solution. Schwicker⁴ adds an excess of potassium iodate solution to the acid solution of the ferrocyanide and estimates the unreacted iodate by titration with a decinormal potassium bisulphite solution.

Recently Gopala Rao and Viswanadham⁵ and Gopala Rao and Ramanjaneyulu⁶ have found that sodium vanadate provides an excellent oxidimetric reagent which possesses some special advantages over potassium permanganate and potassium dichromate. We have now made experiments to see if sodium vanadate could be successfully employed for the volumetric estimation of potassium ferrocyanide. 5 mls. of 0.05 potassium ferrocyanide solution were taken into a beaker, diluted to about 150 ml. with distilled water and acidified with 10 ml. of about 15 N sulphuric acid. The solution

was titrated with 0.05 sodium vanadate solution, using 0.5 ml. of diphenyl benzidine solution as an internal indicator. At the end point, the colour changes from a pale green into a blue violet. We found that the colour change is sharply noticeable only when the overall acidity of the solution is above normal and the concentration of the ferrocyanide is not more than N/600. If the concentration exceeds this limit the solution must be suitably diluted. From the results tabulated below, it will be seen that the method gives accurate results under the conditions prescribed.

Amount of potassium ferrocyanide, $K_4Fe(CN)_6 \cdot 3H_2O$, in milligram mols.

By weight	By permanganometric titration	By vanadometric titration
0.2679	0.2682	0.2678
0.5358	0.5365	0.5356
0.8037	0.8047	0.8033
1.0716	1.0704	1.0712
1.3395	1.3417	1.3390
1.6074	1.6071	1.6092

We have also found that the estimation of ferrocyanide by vanadate can be accurately carried out even in the presence of hydrochloric acid, oxalic acid, etc., where permanganate fails. Details are communicated for publication elsewhere.

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A STUDY OF *CERCARIA FRASERI* BUCKLEY, 1939 IN MADRAS

IN the course of an investigation of the life-histories of some trematodes, a diplostome amphistome cercaria was found to issue from specimens of *Indoplanorbis exustus*, first on 15th September 1941 and

on many occasions subsequently, from various localities in the vicinity of Madras. The structural details which determine its taxonomic position are the heavy pigmentation, the presence of well-defined oral pouches, and independent lateral excretory canals showing dichotomy at the anterior ends. The rediæ are of the characteristic type with three pairs of flame-cells, but no locomotor appendages, and contain a second generation of rediæ, or cercariæ. When we had recourse to previous studies on this group of cercariæ, we found it possible to distinguish our form from all those of the Diplocotylea described hitherto, except *Cercaria fraseri* which Buckley (1939) obtained from the same species of snail in Assam, India, although the recurrent branch of each lateral excretory canal figured by this author is not always to be seen.

In a recent communication, Peter and Mudaliar (1948) remark erroneously that only two diplocotyle cercariæ—*Cercaria Indica* XXI Sewell, 1922 and *Cercaria kylasami* Rao, 1932—have been reported from India. Unacquainted with the literature on the subject, they further believe that their larva is new, which is not so. The characters given by them are precisely those which mark *C. fraseri*, according to Buckley's description and our own observations as well, and it is beyond doubt that they have been dealing with only *Cercaria fraseri*.

Experiments have been conducted to augment our knowledge of the biology of these cercariæ, their discharge from the snails, their encystment and behaviour in relation to environmental conditions, their association with other known amphistome cercariæ, their distribution in and away from Madras, and their host-specificity. They seem to be selective, like *Cercaria Indica* XXVI, in their intermediate host, as on no occasion was *Limnæa* from the same tanks ever observed to harbour them. *Cercaria Indica* XXVI, the larval form of *Cotylophoron cotylophorum* has been found to be a frequent associate of *C. fraseri*.

In an attempt to obtain their adults, 5083 encysted cercariæ (*C. fraseri* and *Cercaria Indica* XXVI) were administered to a he-buffalo calf on 8th March 1946, and over 20,000 to a pigling on 16th May 1946, expecting that *C. fraseri* might grow into *Homalogaster poloniae* in the calf or *Gastro-*

discoides hominis in the pig. Daily microscopical examination of the fæces of both was made, and since no evidence of infection in the pigling appeared it was discharged on 21st Nov. 1946. But, in the calf which had been stall-fed for many months, trematode eggs were first seen on 12th July 1946 (4 months 4 days later) and at autopsy on 11th Nov. 1946, nearly 2,000 adult amphistomes were recovered from the rumen. A small proportion of them when examined proved to be *Cotylophoron cotylophorum*, apparently grown from *Cercaria Indica* XXVI. The negative result in both animals, in so far as *C. fraseri* is concerned, is in accord with that obtained by Buckley (1939).

Buckley (1939) considers it unlikely that its adult might be *Gastrodiscus secundus*, in view of its differences from the cercaria of the nearly related species *G. ægyptiacus*. Looss (1896) draws attention to the presence, in the cercaria of *G. ægyptiacus*, of an œsophageal bulb, a distinctly different pattern of the excretory system in the body, of external pores for the excretory canal in the tail, and of locomotor appendages in the younger rediæ, all of which are absent in *C. fraseri*. If these considerations have any significance against the adult of the latter being *G. secundus*, the only other equine amphistome with oral pouches—but lacking an œsophageal bulb and commonly met with in Madras is *Pseudodiscus collinsi*.

Parasite	CERCARIA		REDIA
	oral pouches	œsophageal bulb	locomotor appendages
<i>Gastrodiscus ægyptiacus</i>	present	present	present
<i>Zygocotyle lunata</i> ..	present	present	absent
<i>Cercaria fraseri</i> ..	present	absent	absent
<i>Cercaria frondosa</i> ..	present	absent	present

Ecological factors favour yet another line of argument. The frequent occurrence of *C. fraseri* in companionship with *Cercaria Indica* XXVI (the larva of *C. cotylophorum*) in the same, or in different, specimens of *Indoplanorbis exustus*, and occasionally with *Cercaria Indica* XXIX (the larva of *Fischæderius elongatus*) in *Limnæa* from the same tanks, strongly suggests that its host may also be a domestic ruminant. This possibility is further supported by the

record of *C. fraseri* from a tank of the Hosur Cattle Farm which could have been visited only by cattle, sheep or goats among the large animals. However, this cannot eliminate the possibility of a parasite of monkeys, aquatic birds or lower water vertebrates occurring in such places, since these hosts could contaminate even confined waters. In that event, the adult parasite is probably a Cladorchid amphistome of the kind that has pharyngeal pockets without an œsophageal bulb.

In the light of these conflicting evidences, and of the misleading observations made on *Cercaria Indica* XXVI before it was proved to be the larva of *C. cotylophorum*, it would seem expedient to conduct carefully controlled experiments for determining the adult of *C. fraseri* conclusively.

This preliminary discussion will be published in detail elsewhere.

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December 21, 1948.

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LIFE-HISTORY, BIONOMICS AND CONTROL OF SWEET POTATO WEEVIL—*CYLAS FORMICARIUS* F. IN BOMBAY PROVINCE

SWEET POTATO is regarded an important vegetable both because of its keeping quality and its food value. Of 12,928 acres under sweet potato in Bombay Province (1946-47) about 55% of the area is concentrated in the districts of Belgaum, Satara and Sholapur only. Of the various pests, namely, *Aspidomorpha miliaris* F., *Diacrisia obliqua* W. and *Cylas formicarius* F., attacking this crop the last one is a major pest, which is very widely distributed and causes great damage to the sweet potato tubers as well as to the mature stems.

Systematic investigations on this pest therefore, were started in 1947 at Padegaoon Research Station with a view to studying

its life-history, bionomics and control since its damage seemed quite alarming and information of any practical utility was not available in this country. The incidence of attack by this pest to the tubers alone extended upto 59.9% in an area where the crop was repeatedly grown. Apart from the damage done to the tubers, the weevils cause considerable damage to the mature stems of the vines within which the larvæ tunnel and arrest the vigour of the plants. The average number of developed stages per foot of the draws of the vines, varied from 1.5 to 3.3 while the maximum number of developed stages found in a single tuber of the dimensions 16.5 × 4.3 cm. was 65 out of which 44 were larvæ, 11 pupæ and 10 adults.

The nature and extent of damage, the life-history and the seasonal history have been studied and some of the control measures tried. Experiments to study the effects of manuring and irrigation on the relative infestation of the pest indicated that with somewhat heavy manuring and irrigation at an interval of 7 days, the percentage of infestation in the tubers was 3.02 which was the lowest as against the highest percentage of 17.2 in the plots with normal manuring and delayed irrigations at fortnightly intervals. The percentage of infestation with normal manuring and normal irrigation of 10 days' interval was 8.7. The incidence of attack in relation to other cultural treatments as date of sowing and spacing, etc., was also studied and on the whole, the red variety of sweet potato seems to be more susceptible to weevil attack than the white one.

The duration of life-cycle may occupy 23 to 45 days with the egg-stage lasting for 5-10 days, the larval stage 14-24 days and the pupal stage 4-11 days. The longer durations however, are met with in winter. The pest breeds throughout the year and deposits its small, oval, whitish eggs singly, both in the mature stems and within the tubers when they are formed. The larvæ and pupæ are found both in the stems and tubers. The freshly emerged adult weevil stays for a couple of days within the larval tunnel before it comes out. Usually the males outnumber the females and their percentage throughout the year vary from 53.4 to 67.0. No alternate host-plant has been recorded

even though wild species of *Ipomœa* have been mentioned as host-plants in other countries.

Preventive methods of control such as the use of healthy setts for planting, deep rooting varieties and destruction of adults by chemical or mechanical means are of practical importance. Preliminary insecticidal trials with Gammexane and Hexy-clan (BHC group) have yielded encouraging results in the control of the pest and the results are being confirmed.

The detailed information regarding our investigations will be published separately. Entomological Laboratory, K. N. TREHAN.
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STUDIES IN THE STORAGE OF GUR

IN a previous communication (1949), the authors described a successful method of gur storage under a blanket of ash. While constituting a considerable improvement over current methods, storage under ash was associated with some loss in weight of gur and although highly suited to village conditions, it might possibly be considered a rather drastic departure from existent practice in markets. Experiments were therefore undertaken with the object of devising suitable moisture-proof wrapping materials or containers for storage. Twenty-

five such (comprising various kinds of coatings on paper, cloth, gunny, earthenware, etc.) were under examination, the properties of gur samples in each being periodically studied as described earlier (*loc. cit.*). Ash storage was the basis of comparison.

The undermentioned methods proved effective in maintaining the product in good condition throughout storage:

I. Storage of blocks wrapped in paper coated with (a) Paraffin wax, (b) Mixture of paraffin wax and coconut oil (2:1), (c) Mixture of paraffin wax and castor oil (2:1).

II. Storage of blocks in closed dealwood box lined with paper coated with paraffin wax.

III. Storage of blocks stitched in gunny bag coated with white (zinc oxide) paint.

IV. Storage of blocks in furnace ash.

Of the above methods, I (a) had been reported to have shown satisfactory results in preliminary experiments conducted at the Indian Institute of Sugar Technology, Kanpur (private communication) and was included in order to test its utility under the more humid conditions at Pusa. Methods I (b) and I (c) were modifications of the same, aiming at reduction in cost.

It would appear from the list of effective methods that paper coated with paraffin wax is a suitable wrapping material and a mixture of wax with an oil (2:1) also

TABLE I

Showing statistical comparison of properties of Co 313 gur under different methods of storage

(Figures are means of the whole storage period. Detailed data omitted for brevity)

Method No. Characters 1	I (a) 2	I (b) 3	I (c) 4	II 5	III 6	IV 7	Conclusions 8
1 Sucrose per cent.	76.25	78.12	78.60	79.35	78.47	80.50	CD at 5% = 0.92, CD at 1% = 1.23 At 5%: <u>IV II I(c) III I(b) I(a)</u> At 1%: <u>IV II I(c) III I(b) I(a)</u> Highly significant.
2 Glucose per cent.	4.35	4.72	4.86	3.96	4.86	3.48	CD at 5% = 0.43; CD at 1% = 0.58. At 5%: <u>(III I(c)) I(b) I(a) II IV</u> At 1%: <u>(III I(c)) I(b) I(a) II IV</u> Highly significant
3 Moisture per cent.	5.13	5.80	5.41	4.93	5.83	4.35	CD at 5% = 0.40; CD at 1% = 0.53 At 5%: <u>III I(b) I(c) I(a) II IV</u> At 1%: <u>III I(b) I(c) I(a) II IV</u> Highly significant
4 Millieq. acid in 100 g.	19.34	19.55	19.07	19.34	20.63	18.01	CD at 5% = 0.68; CD at 1% = 0.91 At 5%: <u>III I(c) I(b) I(a) II IV</u> At 1%: <u>III I(c) I(b) I(a) II IV</u> Highly significant

serves the purpose. Gunny bags coated with white (zinc oxide) paint are suitable containers and cheap coats of similar nature might prove useful.

It was observed that while ash storage permitted of no deterioration in colour, there was considerable darkening in the other methods. A satisfactory level in respect of chemical criteria was maintained in all cases, although ash storage manifested a distinctly superior trend (Table I). On the other hand, no weight losses were recorded in any of the new methods, as opposed to losses of 11-12 per cent under ash storage.

As compared to ash storage, these methods are necessarily expensive and need to be adapted for commercial application. While their economics require detailed examination, the observations recorded here are of interest, as containing the germ for development. Further studies are in progress.

This work was done as part of the Sugarcane Research Scheme in Bihar, being financed jointly by the Government of Bihar and the Indian Central Sugarcane Committee, to whom grateful thanks are due. The assistance rendered by Mr. K. S. Bandyopadhyay in statistically analysing data presented here is also acknowledged.

Central Sugarcane Research Station, Pusa,
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January 23, 1949.

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Proc. Ind. Acad. Sci., 1949, 29, 3.

CRUDE COMMON SALT AS A FAIRLY GOOD SOURCE OF DIETARY CALCIUM IN THE CASE OF SOUTH INDIANS

ON analysing a specimen of a basal South Indian rice diet,* representing the average consumption per subject per day, in connection with some human metabolism experiment, it was observed that it contained about 0.8 gm. of calcium. This high value of calcium was much more than expected as the various ingredients chosen for the diet were of low calcium content. To account for this high calcium content, all the ingredients of the diet were analysed for calcium and it was found that crude common salt was responsible for this. 50 gm. of the salt were added to the diet to

make it tasty; the calcium supplied by this quantity of salt alone being about 0.3 gm.

The normal intake of common salt is about 12 gm. per day; but in South India, an adult consumes about 50 gm. of crude common salt which he takes mainly in spicy preparations like vegetable soup (*Sambar*), *Rasam*, and *Uppuma*. It was therefore of much interest to see how the subjects keep themselves in calcium balance with such a high intake of calcium from the common salt and also to compare the results with those of the subjects receiving refined salt.

Six healthy adult human subjects were used for the experiment. Each subject received the diet, the composition of which is mentioned above. The quantity of food served to each subject was the same during the two periods assuring the same caloric intake. *Uppuma*, a common South Indian preparation of rice flour was served to each person during both at breakfast and at tea time and cooked rice with *sambar* and vegetable curry was served during lunch and dinner. Each experimental period lasted for seven days; the first three days were observed as a preliminary period, and the urine and faeces of the subsequent period of four days were collected quantitatively. There was a rest period at one week between the two successive feeding periods.

Data on calcium balance are expressed in
mg. per day

Subject	Calcium metabolism with crude common salt					Calcium metabolism with refined salt					
	Food* cal- cium intake	Excretion			Balance	Food† cal- cium intake	Excretion			Balance	
	Urinary	Faecal	Total			Urinary	Faecal	Total			
H.M.	790	162	395	557	+233	501	178	351	529	-28	
J.C.	..	174	473	647	+143	..	135	313	448	+53	
M.D.	..	131	444	575	+215	..	194	322	516	-15	
H.B.	..	145	571	716	+74	..	113	301	444	+57	
K.B.	..	192	382	574	+216	..	144	315	459	+42	
B.B.	..	183	632	815	-25	..	153	396	549	-48	
Average					.. +142	Average					.. +10

* Calcium supplied by 50 gm. of crude salt alone being 0.301 gm.

† Calcium supplied by 50 gms. of refined salt alone being 0.04 gm.

Calcium in the food, salt and faeces was estimated by the method of McCrudden.¹ Urinary calcium was measured according to the method of Shohl and Pedley.² The data on calcium intake excretion, and balance are given in the above table.

From the above data it is seen that in the case of crude salt, all the subjects excepting one, are on the safe side of positive calcium balance with an average of +142 mg. balance, while in the case of refined salt three out of six subjects show negative balance, the average calcium balance being only +10 mg.

These findings show that the crude common salt is a useful source of calcium and can partly supplement the South Indian rice diet which is deficient in that essential mineral.

The various samples of crude salt have been analysed by us for the calcium content, the calcium content varies from 0.48--0.72 gm. per 100 gm. of the salt.

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Bangalore,
January 27, 1949.

* The composition of the diet was 675 gm. of polished rice; 40 gm. thur dhal; 10 gm. Bengal gram; 200 gm. vegetables, i.e., potatoes, brinjals, onions; 1 oz. of groundnut oil; and a small amount of spices, tamarind and chillies (Tamarind 25 gm., dry chillies 12 gm. and other spices 10 gm.)

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COMMERCIAL D.D.T. AS AN INSECTICIDE ON SUGARCANE CROP

D.D.T. (Dichloro-diphenyl-trichloro-ethane) as sold in the market is dissolved in kerosene oil or its emulsion with water and is intended primarily for use against mosquitoes and other domestic insect-pests such as cockroaches, bed-bugs, etc. Recently some firms have put for sale their own brand and claim beneficial effects for them against certain crop insect-pests such as leaf-hoppers. Early in September last, one such preparation diluted with water to 0.3% concentration was used against pyrrilla on sugarcane at Motipur (District Muzaffarpur). A week after spraying, distinct chlorotic spots were visible on the

lamina and midribs all over the sprayed area. The leaf material showing these discoloured spots where the liquid had accumulated into droplets and dried up, was preserved in Formalin-Acetic-Alcohol.



FIG. 1

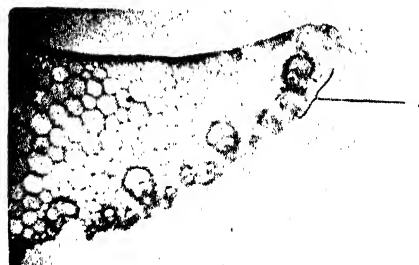


FIG. 2



FIG. 3

FIG. 1. T.S. of lamina showing disruption of epidermis which is intact at a ($\times 60$)

FIG. 2. Part of T. S. of midrib showing extensive disintegration of tissues. Blackish substance is present in Xylem vessels and in parenchymatous cells at b ($\times 40$).

FIG. 3. Part of T.S. of midrib showing the weakening of middle lamella as indicated by regular tearing away of cells at c ($\times 250$).

Hand sections (Figs. 1 and 2) through these spots showed that liquid affected the plant tissues adversely, both in the lamina and the midribs. The lumen of long cells

of epidermis in the affected area was occupied by opaquely black substance insoluble in water, alcohol and xylol. The neighbouring cells containing chloroplasts were similarly affected, and in some cases xylem and phloem were rendered functionless as they were choked by this substance. In the case of sclerenchymatous cells forming the ridges of a midrib, middle lamella appeared to have been considerably weakened with the result that they were unable to hold the cells together while the material was being sectioned (Fig. 3). Sometimes these cells of the vascular sheath also contained this blackish matter.

In another experiment carried out at Motihari (District Champaran) where stock solution of D.D.T. dissolved in a mixture of turpentine and toluene, was diluted to 0.2% and lower concentrations with water before use as a remedial measure against white fly, no such discoloured spots were visible on the leaves even after four weeks. The study of juice attributes showed that concentrations higher than 0.2% had adversely affected the sucrose content of cane. Further work is in progress.

Central Sugarcane K. L. KHANNA.
Research Station, S. L. SHARMA.
Pusa, Bihar,
February 24, 1949.

NATURE OF BOND IN IONIC CRYSTALS

It is usually assumed that the bonds in the crystals of alkali halides are 100% ionic. This view has been based on the alleged additive relationships existing in the internuclear distances, molar refraction, diamagnetism, binding energy, &c.

A detailed examination of the data on the above properties will however reveal the marked departure from the law of additivity.

In the present paper we have shown that the data on the crystal energy is completely in agreement with the partial ionic nature of the bonds in the crystals.

The energy of the crystal has been calculated by Born and co-workers by applying the equation $U = A \left\{ \frac{e^2}{r} \left(1 - \frac{1}{n} \right) \right\}$,

where A is Madelung constant, r is the in-

ternuclear distance. The values of n, the repulsion coefficient, vary from 6 to 12.

It has been pointed out by the present authors (see previous note) that the energy

of a bond A-B is the sum of ionic $i \frac{e^2}{r}$ and

covalent $(1-i) \sqrt{D(A-A)D(B-B)}$ energy. The energy of the bond in the crystal should be given

$$U = A \left\{ i \frac{e^2}{r} + (1-i) \sqrt{D(A-A)D(B-B)} \right\} \quad (1)$$

where U is the observed crystal energy, A is the Madelung constant.

Following table gives the results for the ionic character calculated from crystal energies by using equation (1).

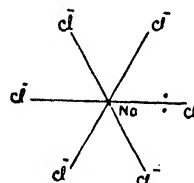
Bond	Crystal Energy	Distance		Ionic character	
		Crystal	Gas	Crystal	Gas
NaCl ..	180.4 ^P	2.81 ^M	2.51 ^M	0.83	0.64
NaBr ..	171.7	2.98	2.64	0.86	0.64
NaI ..	160.8	3.23	2.90	0.86	0.45
KCl ..	164.4	3.14	2.79	0.85	0.74
KBr ..	157.8	3.29	2.94	0.86	0.70
KI ..	149.0	3.53	3.23	0.86	0.71
CsCl ..	153.2	3.66	3.06	0.91	..
CsBr ..	149.6	3.71	3.14	0.93	..
CsI ..	136.1	3.95	3.41	0.90	0.74

P—Pauling, *The Nature of the Chemical Bond*.

M—Maxwell and Mosley, *Phys. Rev.*, 1937, **52**, 968.

Discussion.—The ionic character in crystals is systematically higher than the gas values owing to increased internuclear distance r. A plot of i against r^2 shows that the ionic character is directly proportional to r^2 , i.e., dipole moment is proportional to r^3 , i.e., to polarisability.

The partial ionic character in the crystal can be explained quantitatively on the basis of covalent-ionic resonance in a unit NaCl_6 . [cf. Pauling, *Nature of the Chemical Bond*, p. 72]. In the structure



in which a sodium atom is surrounded by six chlorine atoms, it will not form more

than one covalent bond. Hence the average ionic character of each bond will be 5/6, i.e., 83% which is in good agreement with the values (83—86%) calculated from the partial ionic character of bond energies. Similarly in the case of caesium chloride each caesium being surrounded by eight chlorines and forming one covalent bond the partial ionic character should be $7/8 = 0.875$ which compares favourably with the values .91, .93 and .90 for caesium chloride, bromide and iodide respectively.

A further support to the partial ionic character of alkali halides comes from the data on magneto-optical anomaly (Faraday effect) of these salts found by Darwin and Watson (1927), ($r = 0.8$) and recently by Ramaseshan (1948), ($r = 0.85$) and from the dielectric constants and dipole moments as shown by us in a previous note.

Indian Inst. of Sci., S. K. KULKARNI JATKAR.
Bangalore 3, (Miss) S. B. KULKARNI.
March 5, 1949.

1. Darwin and Watson, *Proc. Roy. Soc.*, London, 1927, **114A**, 474. 2. Jatkarn and Kulkarni, *Curr. Sci.*, Under publication. 3. Ramaseshan, *Proc. Ind. Acad. Sci.*, 1948, **28A**, 360.

IONIC CHARACTER OF HYDROGEN AND ALKALI HALIDES

THE object of the present note is to point a remarkably simple relationship between the internuclear charges and ionic character.

The dipole moment of hydrogen halides in gaseous state as measured by Smyth and Zahn are in agreement with the measurements of dielectric constants of pure solids, liquids and solutions by using a new equation as shown elsewhere. The experimental values of the ionic character are 0.43, 0.17, 0.11 and 0.05 for HF, HCl, HBr and HI respectively.

Table I shows that relationship between ionic character of hydrogen and alkali halides as given by $\frac{Z_A}{Z_A + Z_B} \times n$ where Z_A, Z_B are the nuclear charges and n is a screening constant which is 8/8 for CsF and increases to 8/3. The calculated ionic character of HF (0.267) while in agreement with the bond energy data is lower than the observed value 0.43.

The dipole moments of alkali halides in vapour state have been determined by the molecular beam method. Scheffer's values are $\sqrt{3}$ times lower than those obtained by Rhodabush. No data is available for NaCl and NaBr in vapour state. The calculated values of ionic character ($Z_A/Z_A + Z_B$) $\times n$ seem to be in good agreement with ionic characters obtained from Rhodabush's data. In view of the fact that Cs is the most electro-positive and F is the most electro-negative of all the elements, the high value 0.86 for CsF is quite reasonable and is in agreement with the value 0.91 assigned by Smyth.

TABLE I
Ionic Nature of Hydrogen and Alkali Halides (Gases)

Bond	Distance	$\frac{Z_A}{Z_A + Z_B}$	n	Ionic nature	
				cal. $\frac{Z_A}{Z_A + Z_B} \times n$	obs. $\frac{\mu}{e.d}$
HF ..	0.92	0.100	8/3	0.267	0.43
HCl ..	1.23	0.0557	"	0.149	0.17
HBr ..	1.43	0.0278	"	0.074	0.11
HI ..	1.62	0.0183	"	0.049	0.052
NaCl ..	2.51	0.393	8/6	0.64	..
NaBr ..	2.64	0.239	8/3	0.64	..
NaI ..	2.90	0.174	"	0.45	0.35 ^s
KCl ..	2.79	0.528	8/6	0.71	0.70 ^R
KBr ..	2.94	0.350	8/4	0.70	0.47 ^s
KI ..	3.23	0.264	8/4	0.71	0.77 ^R
					0.71 ^R
					0.44 ^s
CsF ..	2.60	0.850	8/8	0.86	0.58 ^{mu}
					0.91 Smyth
CsI ..	3.41	0.509	8/6	0.68	0.74 ^R

P—Pauling, L., *The Nature of the Chemical Bond*.

S.—Sheffers, *Phys. Zeit.*, 1934, **35**, 425.

R—Rhodabush, *J. Chem. Phys.*, 1933, **4**, 372.

Hu—Hughes, H. K., *Phys. Rev.*, 1943, **70**, 570.

Ind. Inst. of Sci., S. K. KULKARNI JATKAR.
Bangalore 3, (Miss) S. B. KULKARNI.
March 5, 1949. S. N. GOPALASWAMY.

BOND ENERGY AND IONIC CHARACTER OF HYDROGEN AND ALKALI HALIDES

A STRONG support to the values of the ionic character of bonds should naturally come from bond energy data. Considerable amount of work has been done on this

subject using the empirical electro-negativity data of Pauling.

It is well known that the energy of a bond between unlike atoms is greater than the energy of a normal covalent bond between these atoms. According to Pauling the arithmetic mean or preferably the geometric mean of the bond energy values $D(A-A)$ and $D(B-B)$ is the energy of the ideal normal covalent bond between the atoms A and B. The additional bond energy $\Delta i = D(A-B) - \frac{1}{2}\{D(A-A) + D(B-B)\}$ was taken as the additional resonance energy due to the extra ionic character of the bond. In the present paper we have calculated the bond energy based upon the partial ionic character $\Delta i = D(A-B) = (1-i)\sqrt{D(A-A) \cdot D(B-B)}$
 $= i \frac{e^2}{r}$ where $\frac{e^2}{r}$ is the Coulombic energy.

In Table I the values of Δi are calculated by using the theoretical ionic characters given by $i = \left(\frac{Z_A}{Z_A + Z_B} \right)^2 \times n$ which are close to the observed (cf. previous note).

TABLE I

(A) Bond energies of homopolar bonds

Bond	Energy _p	Bond	Energy _p
H-H	103.4	I-I	35.4
F-F	70.0	Na-Na	18.4
Cl-Cl	56.9	K-K	12.6
Br-Br	45.2	Cs-Cs	10.1

(B) Bond energy and partial ionic character

Bond	Distance r_p	Energy $D(A-B)_p$	i (cal.)	Ionic binding energy	
				cal. $i \frac{e^2}{r}$	obs. Δi
HF	0.92	147.5	0.267	96.0	91.0
HCl	1.27	102.7	0.149	38.0	37.0
HBr	1.41	87.3	0.074	19.0	24.0
HI	1.61	71.4	0.049	12.0	14.0
NaCl	2.51	97.7 ^{Pi}	0.64	85.0	87.0
NaBr	2.64	88.5 ^{II}	0.64	81.0	76.0
NaI	2.90	72.9 ^{II}	0.45	52.0	55.0
KCl	2.79	101.4 ^{Pi}	0.71	83.0	97.0
KBr	2.94	91.3 ^{II}	0.70	87.0	89.0
KI	3.23	78.9	0.707	71.0	73.0
CsF	2.60	131.9	0.86	110.0	128.0
CsI	3.41	75.0 ^{Sp}	0.91 ^{Smyth}	116.2	129.5
			0.68	72.0	70.0

P—Pauling, *The Nature of the Chemical Bond*.

Pi—Pitzer, *J. Amer. Chem. Soc.*, 1948, **70**, 2141.

H—Herzberg, *Molecular Spectra and Molecular Structure*.

Sp—Spencer, *Molekulspektren*.

The agreement between the results given in the last two columns is well within the uncertainties in the values of the bond energies.

Gen. Chem. Sec., S. K. KULKARNI JATKAR.

Ind. Inst. of Sci., (Miss) S. B. KULKARNI.

Bangalore 3,

March 5, 1949.

ON RAPID VOLUMETRIC METHODS FOR THE ESTIMATION OF SILVER, BARIUM AND STRONTIUM IN AQUEOUS SOLUTIONS

Determination of Silver.—Though there are quite a number of methods for the quantitative determination of silver in aqueous solutions, a simple and rapid volumetric method has been described in this note. The method consists in the addition of a known excess of standard hydrochloric acid to a measured volume of silver solution, so as to ensure complete precipitation of silver chloride. Now, the excess of the acid remaining unused may be determined by titration against standard alkali solution using phenolphthalein as an indicator. The total amount of acid being known, the amount of hydrochloric acid reacted with silver ions may be found. The end point in this case is quite sharp and it has been found that the deviations in the results lie within permissible error. Since the solubility product of silver chloride is 1.5×10^{-10} at 25°C ., and that of silver hydroxide at the same temperature is 2.2×10^{-8} , there are no chances of alkali being used up by silver chloride to form silver hydroxide.

Determination of Barium and Strontium.—

A similar method can be used for the estimation of barium and strontium in aqueous solutions by employing sulphuric acid for precipitating insoluble barium or strontium sulphate. The excess of sulphuric acid reacted with barium or strontium can be known. In this case too, the possibility of any reaction between the insoluble sulphate and alkali is absent, because the hydroxides of barium and strontium are far more soluble than the sulphates. It has been observed that the results

are quite satisfactory as found by actual determinations of these metals.

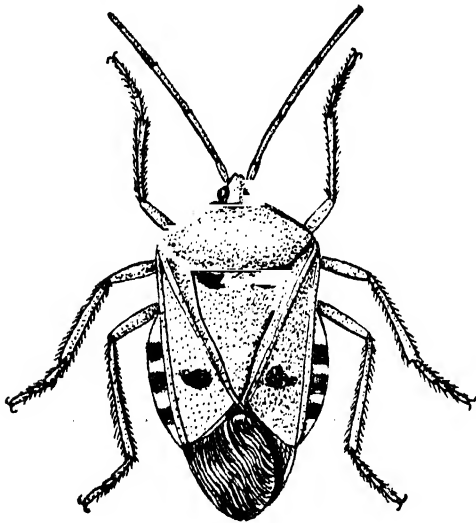
The principle involved in the above methods is well known and does not claim any originality. The methods are not intended to replace the standard methods, but can be profitably used in cases where rapid methods ensuring sufficient accuracy may be needed. It is suggested that similar methods may be applied for the volumetric determination of other metals also in aqueous solutions, which may be precipitated by acids or alkalis, remembering of course that adsorption does not play so important a role, as to interfere with the accuracy of the results obtained with the method.

Department of Chemistry,
University of Saugar,
November 22, 1948.

ARUN K. DEY.

AN UNRECORDED INSECT PEST OF THE CASHEW TREE (*ANACARDIUM OCCIDENTALE*, L.) IN SOUTH INDIA

DURING the flowering and fruiting season of Cashew trees from November to May in 1946-47, a certain kind of bug was noticed in large numbers severely attacking Cashew trees growing along the West Coast, particularly of Travancore. As far as the writer is aware, there is no published record of these bugs on Cashew trees.



.Dorsal view of the bug

The bugs belong to the family Pentatomidæ of the order Rhynchota. Preserved

specimens sent to the Government Entomologist, Coimbatore, were identified as *Catacanthus* sp. nov., very near *Catacanthus incarnatus* Dru. belonging to the same family. The figure shows the dorsal view of the bug. In the morphological characters these bugs resemble very closely of *Catacanthus incarnatus*, except for a few minor differences. *Catacanthus incarnatus*. Dru. is not known to occur on Cashew trees. Lefroy¹ mentions it as an unimportant insect from an economic point of view.

The bugs seem to prefer the very young fruits and embryonic leaves. They first hover round the bunch of fruits in order to select suitable site for feeding. They suck the sap and the tender resin by thrusting their long, pointed proboscis into the fruits. At a particular place they sit and continue to suck for about a period of five to ten minutes, after which they search for a different place to feed on. On an average one bug from early morning to about 10 a.m. was noticed to alight on nearly fifteen to twenty places and makes an equal or more number of punctures. Thus the innumerable bugs puncture all the fruits and tender leaves of a tree in a very short time. On an average 1,000 to 1,500 bugs were noticed on one tree.

As soon as the proboscis of the bug is withdrawn from the fruit, the ever oozing resin and sap flow out through the puncture. Since the resin is very corrosive, as it flows over the soft and tender parts of the fruit, it corrodes the green and smooth regions of the skin. The decay of the few superficial cells of the fruit favours the growth of harmful fungi. Thus the damage of the fruits which is started by the bugs is completed by the fungi attack. Though not seriously, the leaves are also affected to some extent as a result of innumerable punctures made by the bugs. The bugs, thus, are a menace to the Cashew planters, which are reported to bring down the yield of the Cashew trees to a great extent.

Full details on the habits and biology of the bug will be published elsewhere.

Agri. Research Inst., TRUPAPUR A. DAVIS.
Coimbatore,
February 16, 1949.

1. Lefroy Maxwell, *Indian Insect Life*, 1909, Part II.

PHOSPHORUS OXYCHLORIDE, A NEW CONDENSING AGENT FOR THE CHALKONE FORMATION

THE chalkones which serve as useful starting materials for the syntheses of flavones and related compounds, are usually prepared by condensing aromatic ketones with aldehydes in presence of a suitable agent such as hydrochloric acid¹ or alkali.²

In connection with our work on chalkones we observed that phosphorous oxychloride smoothly effected the condensation of acetophenone with benzaldehyde; the benzylidene acetophenone was obtained in good yields.

As this agent was not used before for this purpose, its applicability was investigated in several cases. It has been found that chalkones are formed in good yields from acetophenone, *o*- and *p*-hydroxy and *m*-nitro-acetophenones, using several aldehydes.

The general procedure is to add a few drops of the reagent to the mixture of aldehyde and ketone in equimolecular proportions. The reaction mixture after keeping overnight is decomposed with cold water and the separated chalkone is identified by a mixed melting point with a known sample.

The full details of this work will be published elsewhere.

M. R. Science Institute, G. N. Vyas.
Gujarat College, N. M. Shah.
Ahmedabad,
December 17, 1948.

1. Claisen, L., and Claparede, *Ber.*, 1881, **14**, 2463.; Russel, A., and Clark, S. F., *J. Amer. Chem. Soc.*, 1939, **61**, 2655. 2. Claisen, L. and Ponder, A. C., *Annalen*, 1884, **223**, 137. For full references and work on Chalkones by Kostanecki, *vide Ber.*, 1912, **45**, 1701. Mahal, Rai and Venkatraman, *J. C. S.*, 1935, 866. Wheeler, *et al.*, *J. C. S.*, 1937-38, 1320, *et. seq.* Seshadri, *et al.*, *Proc. Ind. Acad. Sci.*, 1947, **26A**, 189.

ON THE FOOD OF THE GOONCH BAGARIUS BAGARIUS (HAM.)

THE Goonch is one of the largest siluroids occurring in the major rivers, into the upper reaches of which it migrates for spawning during the monsoons.¹ Its voracious and piscivorous habit is well known; and its teeth, thickwalled baggy stomach and intestines testify this.² Beavan³ has observed this fish feeding on the Spiny Eel, *Mastacembalus armatus* and on the Herring, *Clupea chapra*. Chacko and Job⁴ have recorded young prawns, fish remains and sand in the stomach of the young stages of the species. Analysis of the gut contents of over 100 adult specimens by me has revealed that 14 species of fishes, 2 of crustacea, and 2 of algæ, listed below, constitute the food of this species.

(1) *Labeo fimbriatus*, (2) *Cirrhhina fulungee*, (3) *Osteochilus thomassi*, (4) *Catla catla*, (5) *Amblypharyngodon mola*, (6) *Barbus sophore*, (7) *Barbus stigma*, (8) *Nuria danrica*. (9) *Rasbora daniconius*, (10) *Barilius bendelisis*, (11) *Danio aequipinnatus*, (12) *Chela argentea*, (13) *Chela-phulo*, (14) *Macrones vittatus*, (15) *Palæmon malcolmsonii*, (16) *Palæmon scabriculus*, (17) *Spirogyra* and (18) *Cladophora*.

The marked piscivorous tendency of the Goonch may have an adverse effect on the other fluvial fisheries.

I am indebted to Mr. P. I. Chacko, Asst. Director of Fisheries, Madras, for his guidance and help during the investigation, and to the Director of Industries and Commerce, Madras, for according necessary permission for the publication of the note.

Inland Fisheries Office, G. K. Kuriyan.
8, Ormes Road, Kilpauk,
Madras,
September 1948.

1. Chacko, P. I., *Curr. Sci.*, 1947, **16**, 289-90. 2. Hora, S. L., *J. Bombay Nat. Hist. Soc.*, 1939, **40**, 583-93. 3. Beavan, R., *Freshwater Fishes of India*, London, 1897. 4. Chacko, P. I., and Job, S. V., *Proc. 35th Indian Sci. Cong.*, 1948, **3**, 204.

REVIEWS

Supersonic Flow and Shock Waves. By R. Courant and K. O. Friedrichs. (Interscience Publishers, Inc., New York), 1948. Pp. 464. Price \$ 7.00.

The theory of Supersonic flow and Shock waves is a very fascinating subject of recent development and research. A great deal of experimental work and theoretical investigation in this field may be found spread over a wide range of journals and technical reports, but till quite recently, there were very few books giving a connected mathematical theory of the subject.

The book under review is written by eminent theoretical physicists, who have themselves made important contributions to the principal mathematical methods required in such investigations as well as to the many specific topics such as flow through nozzles, the theory of deflagrations and detonations, formation and decay of shock waves and the interaction of shock and rarefaction waves. The book itself is a revised and enlarged form of an earlier report on the same subject.

The equations for flow problems in the dynamics of compressible fluids are formed with the help of the usual conservative laws of mass, momentum and energy. The changes of thermodynamic state are assumed to be adiabatic except at singularities, where modifications under suitable hypotheses are made. The general equations turn out to be non-linear in character and the aim of the mathematical theory is to solve such equations under given or appropriately formulated boundary and initial conditions. At present, only problems of special types are amenable to exhaustive mathematical treatment. While giving a thorough account of such problems, the book clearly reveals the imperfect state of the present theory and the need for further investigation relating to several aspects of flow problems.

The book consists of six chapters. The first two chapters furnish the necessary mathematical and physical background and a comprehensive treatment of one- and two-dimensional problems is given in Chapters III and IV respectively. Chapters V and VI deal qualitatively with three-dimensional problems under simplifying assumptions.

An outline of the contents of the book now follows,

In the first chapter the necessary thermodynamic notions are given in a suitable mathematical form and the general differential equations of flow are derived. The wave motion in shallow water which is analogous to the non-linear motion of gases is studied in the Appendix. In Chapter II the theory of characteristic curves and characteristics, the theory of simple waves and the method of hodograph transformation are described. The Appendix to this chapter deals with differential equations for functions of more than two independent variables. An exhaustive treatment of one-dimensional flow problems covering several aspects is presented in Chapter III. Rarefaction and compression waves, the formation of an envelope in a compression wave, shock discontinuities resulting from compressive motion are described. Shock wave theory is developed as an irreversible thermodynamical process caused by friction and heat conduction. Shock conditions are derived in several forms. Hugoniot function and Prandtl's relation for shock transition in polytropic gases are obtained. A qualitative description of elementary interactions is included. Collision of two simple waves is treated on the basis of Riemann's theory as well as by the more suitable method using finite differences. Chapman Jouguet reaction processes and hypothesis and Jouguet's rule are considered in some detail. The chapter ends with an Appendix on wave propagation in elastic-plastic material. In Chapter IV the hodograph method of solving special isentropic irrotational steady two-dimensional flow problems is used. Explicit formulæ for Mach lines, angles and cross lines are derived. The analysis of oblique shocks is carried out with the help of the shock polars. The interaction between shock fronts and production of regular shock and Mach reflections, the interaction of a shock and a simple wave are considered. Linearized perturbation methods for determining the flow around profiles are explained. Chapter V is devoted to a qualitative description of flow through nozzles and jets. In Chapter VI cylindrically symmetric steady flow against slender profiles, steady conical flow and non-steady flow with spherical symmetry are discussed.

The book is written in a clear and elegant style. It is profusely illustrated. The biblio-

graphy is extensive. There is a good subject index. The book is very stimulating and deserves to be widely used and appreciated.

T. VENKATARAYUDU.

Fundamentals of Physical Science. By Konard B. Krauskopf. (McGraw Hill Book Company, Inc., New York), 1948. Pp. 676.

The volume under review is a revised edition of the book which was first published in 1941. Many changes have been made in the present edition, namely, a complete rewriting of the chapter on atomic nucleus, addition of a section on the uncertainty principle, introduction of Bronsted's theory in the discussion of acids and bases and increased emphasis on air mass analysis in weather forecasting. A few sections of the first edition have been omitted or shortened because they did not contribute directly to the central theme of the book.

The author states in the Preface that the book is primarily meant for College students who wish to have a general knowledge of the physical sciences rather than a detailed knowledge of any one science. The four sciences of astronomy, physics, chemistry and geology, have been condensed in the book which runs to 650 pages only. It is therefore not surprising to find that many fascinating topics had to be omitted in each one of them while many others had to be touched only lightly. In presenting the subject, emphasis is placed less on the specific accomplishments of science than on how these accomplishments are made possible. The different sciences are not treated separately, as the author wants to emphasise the unity of physical science as a field of knowledge rather than to stress its arbitrary divisions.

The book is divided into six parts, the division being based broadly on the different sciences dealt with in them. They are as follows:—(i) Astronomy and General Mechanics, (ii) General Physics and Early Chemistry, (iii) Modern Physics, (iv) Chemistry, (v) Geology and (vi) Astronomy and Frontiers of Physical Science.

Part I in which is treated the subject of astronomy with special reference to the solar system begins with a description of the efforts of early philosophers to gain an idea of the general structure of the Universe. This is followed by a detailed account of the accepted picture of the sun's family and the origin of the solar system. Fundamental problems connected with gravitational force and motion which are intimately related to the

subject of astronomy are discussed in some detail and quite a few chapters have been entirely devoted for the same in Part I. These are followed by a chapter on energy which is included in Part II. The two succeeding chapters in Part II deal respectively with the three different states of matter, and the kinetic theory of gases. The progress of chemical knowledge during the 19th century is traced in the last five chapters in Part II. The third part is devoted entirely to cataloguing the many developments in physics which took place during the past fifty years, a topic which may be appropriately called modern physics. Many important branches of modern physics, viz., x-rays, radio-activity, radiation, quantum theory, spectroscopy and nuclear physics, are very briefly referred to. In Part IV the author surveys a wide variety of chemical processes. The chemistry of carbon and silicon compounds and the colloidal state of matter have also been discussed in some detail. Part V is devoted to a discussion of the geological materials that are found on the earth and of the natural processes by which these materials are altered. The sixth and the last part is again devoted to the fascinating subject of astronomy. The universe beyond the earth is described here with special reference to the stars and galaxies.

The book is written in a simple style and is well illustrated. Mathematics has been very sparingly used. By stressing the methods of scientific reasoning rather than the results, the book attempts to give to its readers a truer picture of the relationship of science to modern life and thought, better appreciation of the limitations as also the extraordinary power of the scientific method. Nevertheless, as the book covers a very wide field of knowledge, the reviewer feels that it may not be of much use to students undergoing a specific course in any one of the branches of physical science treated therein. It will, however, serve as a useful book for general reading.

R. S. K.

Outlines of Physical Chemistry. By Farrington Daniels. (John Wiley & Sons, Inc., New York; Chapman & Hall, London), 1948. Pp. viii + 713. \$5.00.

The teachers and the students of physical chemistry would receive with interest the publication of Professor Daniel's work. It is a completely revised form of the Getman and Daniel's older work which was regarded as one of the standard text-books on the subject in

America for more than thirty years, its last edition having been published in 1943.

In the preparation of the book under review the author has taken into consideration not only the immediate needs of the student preparing for the examination, but his greater requirements also, namely laying a sound foundation of the subject which may enable him later to devote his mind to its more complex aspects with a thorough understanding, an object very much to the heart of the teacher and the researcher alike.

In its twenty-one chapters, besides the usual subject-matter, the book deals with physical properties and molecular structure, heat work and heat capacity, phase diagram, quantum theory and atomic and nuclear structure—topics which give a sufficiently modern approach to a field wherein every new advance in the knowledge of physical and chemical sciences has left its indelible mark.

A large number of problems at the end of each chapter would undoubtedly provide the reader an insight into the laws governing molecular processes which have their importance not only in the field of pure and applied chemistry but also in apparently diverse fields such as engineering and biology.

A number of mathematical derivations which the author thinks could be 'taken for granted' by the 'hurried student', have been relegated to the appendix. At least some of these in the writer's view could have been incorporated in the text. Such are the evaluation of the constants in van der Waal's equation, calculation of distances between the planes in a crystal, the Carnot cycle, the rate equation, specific diffusion rate and the Bohr equation for the energy of an electron in an elliptical orbit.

Reference should be made to the careful selection of various diagrams and reproductions from photographs. These are always much to the point and references to them in the text have been made in bold types. This is a helpful feature which it should be always advisable to follow. The more uncommon and interesting among them are, atomic and molecular models giving correct interatomic distances and angles (this figure could have been made twice the size, with advantage), Hougen and Watson's chart for the calculation of pressure, volume and temperature of a gas at high pressure values, space models of several three component systems, Maxwell distribution of velocities of nitrogen pentoxide molecules showing the percentage of activated

molecules at different temperatures, representation of relation between activation energy of forward and reverse reactions and the heat of reaction, chart for specific reaction rates at different temperatures for different activation energies and differential ('chromotographic') adsorption and elution of rare earths.

The 'Outline' thus provides from every point of view a desirable text-book which is eminently suited for adoption by our Universities.

B. K. VAIDYA.

Technique of Organic Chemistry. Vol. II. (Interscience Publishers, New York), 1948. Pp. 219. \$5.00.

This is the second volume of the very valuable series on the Technique of Organic Chemistry, edited by Dr. Arnold Weissberger of the Eastman Kodak Research Laboratories. The first volume which was in two parts dealt with the Physical Methods of Organic Chemistry, and the present volume comprises chapters on Catalytic Reactions by V. I. Komarewsky and C. H. Riesz, Photochemical Reactions by W. Albert Noyes, Jr. and V. Boekelheide, and Electrolytic Reactions by Sherlock Swann, Jr. The theoretical background, procedure and apparatus employed in carrying out the reactions, their scope and limitations, a general bibliography and numerous references to specific topics are included in each chapter. The book is a link between the organic chemist and the chemical engineer, and will prove to be of the utmost assistance to research workers in both these fields who are concerned with catalytic, photochemical and electrolytic reactions and processes.

The chapter on catalysis contains useful practical details for the preparation of catalysts of different types (Raney nickel, copper chromite and vanadium pentoxide being notable omissions), and an excellent account of the procedure and laboratory apparatus for various catalytic reactions by batch and continuous methods and at pressures ranging from sub-atmospheric to several hundred atmospheres. High pressure technique is treated with a wealth of detail which will be invaluable to the organic chemist who desires to investigate high pressure reactions in general. The emphasis throughout is on apparatus and technique, and there are few references to individual substances prepared by catalytic reactions.

The chapters on photochemical and electrolytic reactions follow a somewhat different plan,

The treatment of technique and apparatus is less detailed, and more attention is devoted to the chemistry of the reactions. The types of photochemical reactions are classified and preparatory details are given for several compounds (e.g., benzopinaconol, p-bromobenzyl bromide, di-n-propyl sulphide). The technically important photochemical rearrangement of ergosterol to calciferol receives, however, only very brief consideration. Chain reactions influenced by light such as photochlorination are described with citations of many examples, and the utility of photochemistry in organic synthesis is fully demonstrated. The chapter on electrolytic reactions covers the ground very thoroughly, and numerous examples of reactions of synthetic value are quoted. The advantages of electrochemical synthesis are set out and should serve as a stimulus for the wider use of electrochemical methods for the preparation of organic compounds as part of the programme of practical work in an Honours course in chemistry.

The indexing is unsatisfactory. Thus hydrogenation and reduction are not mentioned, although examples are given in connection with the preparation of catalysts.

K. V.

The Manufacture of Iron and Steel. By G. Reginald Bashforth, F.I.M. (Chapman & Hall), 1948. Pp. viii+228. Price 21sh.

The author has neatly covered in fair detail practically all the aspects of Iron production. The volume under review should therefore prove extremely useful to Metallurgy students. A typical feature of the book is the latest reference appended throughout the pages in support of the voluminous data condensed in the text.

The contents are neatly laid out and well balanced. Reference to Bihar and C. P. Haematites iron ore belts has not been made in relation to India's iron ore deposits although Mysore Magnetites deposits have been referred to. It may be pointed out the Bihar and Bengal iron ores of India form one of the richest iron ore deposits of the world. Further chapters deal effectively with the technical processes involved in Iron and Ferro-alloy's production.

The language of the book is precise and the information contained should prove useful both to the students as well as to a large measure to industrialists for reference study. The technical details of the processes involved

are quite comprehensive. The pages on electric reduction of pig iron, however, lack adequate reference to the Swedish processes and their results. This may be ascribed to lack of space.

The book is a very useful addition to the metallurgical texts on Iron Production.

B. R. NIJHAWAN.

Chromosome Numbers of Northern Plant Species. By Åskell Löve and Doris Löve. (University Institute of Applied Sciences, Department of Agriculture, Reports, Series B, No. 3, Reykjavik), 1948.

The impact of other botanical sciences on plant systematics has been felt gradually since the beginning of this century. Plant geography has been one of these which has been of much help to taxonomy. The rapid development of genetics and cytology has thrown considerable light on speciation in plants and animals and the aid of these allied sciences appears to be very necessary if real differences between species have to be correctly established by taxonomists. The future taxonomist will, therefore, largely depend on results of cytogenetic investigations in the creation of new species or the delimitation of existing species. Information so far obtained by cytogenetic investigations on the interrelationship of species has been of considerable importance and it points to the future possibilities of gaining more information. There is thus both a scope and a necessity for undertaking work on the study of the interrelationship of taxonomic species from a cytogenetic angle. In this regard the publications of lists of chromosome numbers of plants has to some extent been of help to systematists among others.

The book under review lists the chromosome numbers of the plants of the Scandinavian countries and includes the higher flowering plants, gymnosperms and the pteridophytes. In a previous publication by the same authors the chromosome numbers of the flora of the four Scandinavian countries, viz., Denmark, Finland, Norway and Sweden were recorded but in the present publication the previous information has been amplified by the inclusion of the flora of the Færoes and Iceland. As the authors point out, "the present list is not only a list of chromosome numbers of the species met with in the area but is also a complete list of the floras of the six Northern countries". Thus the publication is of use to geneticists, cytologists and taxonomists.

On page 11 is given an interesting table

which furnishes information on the total number of species present in the six northern countries and the percentage of these cytologically determined. It is observed that a very high percentage varying from over 50 to 90 per cent. of the species of pteridophytes, gymnosperms and angiosperms have been cytologically studied. Another interesting information given is that more than fifty per cent. of the angiosperms of these areas are polyploids.

It would be of considerable help if similar lists of chromosome numbers of the flora of other geographical regions of the world, which would include the known floras of the area, are published.

The publication is most appropriately dedicated to Tischler who was the first to publish a list of chromosome numbers of plants. A key to the use of the publication, an index to synonyms, a bibliography and an index to genera are useful additions furnished.

L. S. S. KUMAR.

Dictionary of Genetics. Compiled by R. L. Knight. Vol. 2 of Lotsaya—A Biological Miscellany. (The Chronica Botanica Company, U.S.A.; Macmillan & Co., Ltd., Calcutta), 1948. Pp. ix+183. Price \$4.50.

Under the editorship of Dr. Frans Verdoorn, the second volume of the series Lotsaya—Biological Miscellany has been issued. This volume is a Dictionary of Genetics prepared by Dr. Knight, Cotton Geneticist, Sudan.

The Dictionary is a comprehensive one, for, terms used in allied subjects, cytology, animal breeding and evolution, have been included. There has been no narrow adherence to these subjects alone, and terms used in animal embryology, and cytologically important chemical terms are included, making a total of about 3,000 entries. This is followed by brief appendices dealing with the formulæ of biometry important in genetics and plant breeding with six relevant tables.

There is a need for a dictionary of this type and in the Preface, the present confusion in terminology is pointed out. This book can be claimed to be a pioneer in this field, for generally the lists compiled by other geneticists have been brief appendices to a text. Dr. Knight has made good use of their compilation. For some of the important terms the definition is given and its author's name cited.

This Dictionary is not one which gives an explanation of new terms to a beginner, but one which tries to define the meanings with

a view to greater precision in their use. A criticism of the definitions is difficult, as the terms are closely bound up with concepts and interpretations in this controversial subject. As an example the following may be pointed out. Strepsitene is termed a misnomer, according to Dr. Darlington, while chromonemata is defined as by Nebel, and Darlington's view is not presented. No simple solution is offered to the difficulty pointed out in the Preface that new words are being coined by research workers for which often the old ones will do, or which could be better constructed and defined. The remedy presumably is for the biologists to bestow greater care on the current usage. For this purpose, this Dictionary is a help and the author has done a service to geneticists.

C. G.

Biological Reactions caused by Electric Currents and by X-Rays. J. Th. Bander Werff, M.D., D.Sc. (Published by Elsevier Publishing Company, Inc., New York, Amsterdam, London and Brussels), 1948. Pp. xii+230. Price 30sh.

Biology is a science much younger than physics; therefore mathematico-theoretical developments in it have been until recently entirely lacking. During the last decade or two, considerable progress has been made towards the logical understanding of many observations which were known but ill understood. Using mathematical analysis and methods borrowed from mathematical physics, the science of mathematical biophysics plays the same role with respect to experimental biology and medicine as mathematical physics does with respect to experimental physics.

Such a book as the above is therefore welcome. It contains a theoretical study of the phenomena of excitation in the nerve by different electric currents and of the biological reactions in tissues caused by x-rays, both based upon a common principle. It is assumed that these cause changes in assimilation and dissimulation processes of metabolism, as a result of some disturbances. However, little further advance is to be expected unless more is known of these metabolic processes of life.

The theory described above has been useful in indicating the possibilities and limitations of x-ray therapy. Its most important result has been to unite the two fields in which so many investigators have spent their energy for so many years.

INDERJIT SINGH.

The Science of Animal Life. By A. M. Winchester. (Van Nostrand Co., New York; Macmillan & Co., London), 1948. Pp. xii+437. Price \$4.50.

There is a general feeling among students that far too many technical terms abound in a study of biological sciences, a part of which at least one has to remember in pursuing a course in them. In order that the beginner may not be spirited away from a study of zoology, Winchester, in the book before us, has tried to avoid as far as possible the use of technical terms explaining, however, their meaning fully wherever they have been employed inevitably. Further, in order to evoke the maximum amount of interest in the student, he has portrayed the subject in an interesting manner.

There are 31 chapters including invertebrates, chordates, and general principles like genetics and embryology, and the book concludes with a glossary and an index. About half the book is devoted for the consideration of the invertebrates while the other half deals with chordates and general principles.

While perusing the book, it is noticed that in fig. 21.3 (p. 238) the olfactory and optic regions are labelled 'nasal foramen' and 'optic foramen' respectively; these terms are inappropriate. Again, in the description of the frog's brain, it is not stated to which part of the original segmentation the diencephalon belongs. The figure of the alimentary system (p. 249) gives a wrong idea with regard to the hepatic duct which is shown independently of the pancreas.

Under aquatic vertebrates, the cyclostomes, elasmobranchs and other fishes are treated. The derivation of the term 'teleos' is misleading. It not only means 'perfect' but also 'end'; in defining 'teleostomi', it may not be justifiable to describe them as 'perfect mouthed' fishes as the author has done, but as fishes having mouth at one end. Undoubtedly the term 'teleostei' would mean fishes which are completely bony. Similarly, in the glossary, the term 'telolecithal' (p. 427) is explained as an egg showing uneven yolk distribution! Under reptilia, the figure (25.5, p. 284) representing the development of an embryo of a reptile or a bird, definitely conveys a wrong idea to the student; the allantois is drawn as a double-walled bag completely enclosing the embryo.

In describing the snakes, the author has indulged in not a little folklore and on page 296, it is most amusing to read 'Unfortunately

the majority of the people hold them in superstitious reverence and they do not kill them for fear that they may be the reincarnation of their late grandmother or other relatives'.

In the chapter on mammals, the fig. 27.1 (p. 325) is drawn to show the developing embryo of a mammal. In this it has failed, for the figure is not of a generalised type and further, the legend reads, that "the allantois has been replaced by the placenta" which is not at all correct.

There are a few printer's devils: 'righ' for 'high' (p. 262), 'Lepisosteus' for 'Lepidosteus' (p. 274) and 'an an exception', for 'an exception' (p. 326).

For a serious student of zoology, the book provides little food for thought, while it may satisfy the requirements of a beginner for whom the figures have been drawn, sacrificing the details. One must congratulate the author on the excellent photographs enlivening the book.

L. S. R.

Storing and Drying Grain—FAO Agricultural Studies No. 6.

Studies of methods used in Canada, the United States and the United Kingdom in drying grain before storage, have been released by the Food and Agricultural Organisation as a stimulus to the spread of information on protection of stored grain from insect and fungal attack. Great stress has been laid on the proper conditioning and storage of grain as the most important factors in preventing losses due to insects and fungi, at an international meeting on infestation of food stuffs held in London in 1947 where the loss was estimated at 33 million tons enough food to keep 150 million people alive for a year.

The methods used in these three highly industrialised countries, while far from ideal to all the countries, will, doubtless, be of help and interest to the other parts of the world.

Canada is very favourably placed in the matter of storing and handling grain because of the low temperature prevailing there throughout most of the year. The United States of America enjoys higher average temperatures and the humidity is also higher in many sections. Grain therefore faces greater danger from infestation and loss there than in Canada; the moisture content of the grain must necessarily be lower for safe storage; the diversity of the crops grown in U.S.A. also makes the problem more difficult.

The United Kingdom is faced with the two-

fold problem of handling and storing imported as well as home-produced grain.

In Canada and U.S.A. the extent to which Science is applied to the handling of cereal crops in the field, is most unusual to other parts of the world. The extensive use of the combine harvester in these two countries, while effecting great savings in labour, has created new storage problems, since, harvesting by combine, ordinarily leaves no time for the grain to dry out between cutting and threshing ; also the cutting of the green weeds with the grain, frequently results in the transfer of moisture from immature weed seeds to the drier grain kernels. The United Kingdom into which the combine harvester is now being rapidly introduced, has now to meet the increased demand for new methods and machines to cope with the new problems of grain storage.

The existing methods of handling, drying and storing grain described in the studies released by the FAO of the United Nations, are many and varied. Strict regulations concerning grain drying in the matter of the moisture content of different grain to be stored and maximum temperature of the hot air in drying grain artificially which are laid down and

enforced are described. Results of experiments on the factors such as—effects of drying conditions on grain temperature and quality and the factor of different initial moistures—and minimum time required for safe drying under desirable and effective temperature are given in detail. The important part played by proper ventilation in safe storage in different kinds of bins is pointed out clearly and natural ventilation as well as that obtained by means of forced air are also dealt with. Useful information on Farm grain driers—Commercial grain driers—and grain drying in elevators—is provided. The national grain Silos in the United Kingdom established during the war as a contribution towards solving the problem of grain drying and bulk storage arising from the introduction of the combine harvester and the great expansion of wheat acreage, are pointed out as a great feature of the country, serving a useful purpose in setting high standards of drying and handling and in dealing with the wettest part of the crop in each year, since, without their being in operation, most of the grain handled by the ordinary and general silos in the country, would have been probably spoiled.

B. K. M.

SCIENCE NOTES AND NEWS

Fishery Research*

Fishery Research is the investigation of problems connected with the production and proper utilization of the fish and other wealth from the waters. The first care of Fishery Research is that the areas concerned shall be fished right up to their fishable limit, but without harming the stock for future years. The investigations are therefore to be directed towards finding out not only the total productivity of the areas but also the correct type of fishing gear and the rate and frequency of fishing, as well as the details regarding the ecology, life-histories and the economic value of the different species of fish themselves. Such investigations provide the basis to evolve stocking policies and regulations for proper fishery management. The other part of Fishery Research aims at

finding out suitable methods to preserve, cure, transport and store the fish and fishery products to ensure the best possible quality.

These investigations require the establishment of well-equipped and well-staffed biological and technological laboratories and seagoing research vessels. Large sums of money are being spent in this direction in all the advanced countries of the world. Japan, for instance, had more than 120 fishery research stations before the war; Russia has fifteen large fishery research vessels to-day; and the United States of America have added just last year a 525 ton vessel fitted with all the latest equipment, to their large research fleet.

In Indian seas, fishing is done only in the inshore regions which form a fraction of the 74 million acres of the continental shelf. Trawling experiments conducted off the coasts of Bombay, Bengal, Madras and Ceylon indicate greater possibilities for fishing the richer beds, but more

* Abstract of a Radio Talk, A.I.R., March 1949, by Mr. K. Chidambaram, M.A., F.Z.S., Assistant Director of Fisheries, Madras.

systematic research has to be carried out to gain a clearer knowledge of the fishing grounds by marine surveying, charting and hydrobiological studies. The Madras Government established the first Fisheries Department in India forty years ago and was later followed by several other Provinces and States and while some amount of work has been done by these Departments with limited personnel and finances, the Indian Fisheries are still in their infancy. Only recently, the Government of India have started biological research stations at Madras (Marine) and Calcutta (Inland) and have planned the establishment of a technological station at Bombay. It is desired that the latter would commence working soon. With effective co-ordination of fishery investigations and better appreciation and encouragement of fishery research among the various Provinces, States and the Centre, one can definitely anticipate an increased production and a proper utilization of the much needed nutritive food from the Indian waters.

U.N. Conference on Resources Utilisation

The United Nations Scientific Conference on Conservation and Utilisation of Resources, it is understood, will be scientific and not policy-making. The conservation and wise use of natural resources are problems of immediate concern to all nations. For the countries ravaged by war, these problems are very urgent as they must use the advanced techniques which will most rapidly bring their farm lands and factories to full productivity. For the highly industrial countries which are experiencing temporary shortages of some of their basic resources such as oil, coal and steel, there is good cause for concern over the rapidity with which they are consuming their stocks of irreplaceable materials. For India, the greatest interest lies in the utilisation of modern methods which will enable her to make sustained use of resources as yet untapped and to build up more productive and diversified economies.

Preventable and costly waste both of renewable and non-renewable resources is a world-wide phenomena. No country, however favoured, has yet succeeded in exploiting to the full the possibilities

which the scientific utilisation of resources offers for a rapid advance in the standard of life. For such an advance the requisite methods and techniques are at hand or in a process of development. For some resources such as soils and forest, proven methods of conservation are available by which the bases of life can be restored, improved and preserved. For other types of resources such as metals, fuels and energy, new techniques have become available which promote rapid industrial development and enable the more effective use of scarce materials and thus help to increase the general well-being of the people. The range of new technological discoveries and their practical application is very wide. It ranges from the processing of low grade minerals to the development of insecticides that result in greater production of grains, cattle or cotton; from the utilisation of wood wastes to the winning of oil from wells; from finding minerals by new geophysical devices to techniques of preventing soil erosion, from producing rain from clouds to the creation of new animal and plant hybrids. The development of these advances in technique and administration is the work of many experts of the various nations throughout the world. No country has a monopoly of the best methods. Every part of the world has contributions to make and significant experience from which those are responsible have much to learn. The store of scientific and practical knowledge is one of the world's great resources. In this the world becomes a family. The fullest mobilisation of this knowledge is essential to equip the nations of the world for the task of raising and maintaining the living standards of their people. The United Nations Scientific Conference on the Conservation and Utilisation of Resources, it is hoped, is a step towards that mobilisation.

The Indian Delegation, it is hoped, will bring back to India from the Conference much useful scientific knowledge which will enable India to make use of the most modern scientific techniques in the various fields of industry and agriculture and will thus help to build up more productive economies which will raise the standard of living of the masses.

Recent Advances in the Chemistry and Technology of Fats

In his Presidential Address before the Physical Sciences Section of the Ceylon Association of Science on "Recent Advances in the Chemistry and Technology of Fats", Dr. Child has briefly surveyed the methods of analysis and structure of fats based upon the publications of Baily (*Industrial Oil and Fat Products*) and of Hilditch (*Chemical Constitution of Natural Fats*).

Plutonium

For the first time Britain has produced plutonium the fissile element which can be used for the creation of atomic power. This is one of the most important steps forward in Britain's atomic energy programme.

The plutonium was made at the Ministry of Supply's Atomic Energy Research Establishment at Harwell. It was extracted from a uranium slug which had been treated for several months in Gleep, the low power atomic pile. Because of the low power at which Gleep operates, the amount of plutonium is small, but it is sufficient for investigating the chemical and chemical engineering problems which will be met in the large-scale handling of plutonium.

Plutonium, which can only be produced in quantity in an atomic pile, does not exist naturally. It was first produced in quantity in 1942 in America and being fissile can be made to break up and give out great energy.

When the slug was unloaded from Gleep it was stored for sometime to ensure that the intense radio-activity decayed so that the experimental work could safely begin. When a uranium slug is taken out of a pile it contains, in addition to plutonium, some unused uranium and some highly radio-active products.

The separation of plutonium and unused uranium from the fission products is a difficult and complicated operation owing to the presence of many different radio-active elements. The final product is in the form of a solution of a plutonium salt.

Professorship of Eastern Religions at Oxford

Oxford University has been offered £42,000 (Rs. 5,60,000) to endow a Professorship of Eastern Religions and Ethics.

A Professorship in this subject has been established for some years on an experimental

basis. Now, by the generosity of its founders, Mr. and Mrs. Spalding of Oxford, it can be placed on a permanent footing. It will also be possible to provide a travelling fund for the use of the professor who holds the post.

The founders make only one condition. It is that a permanent interest shall be built up in the University in the great religions and ethical systems of the East, whether expressed in philosophic, poetic, devotional or other literature. Its influence on art, history, social life and national structure is also to be studied. The aim is to bring together the world's great religions in closer understanding, harmony and friendship.

Its purpose will also be to promote co-operation with other universities, bodies and persons in the East and West pursuing like ends. It is considered that this is likely to be furthered by establishing a permanent professorship at Oxford. The post would normally be held by persons of Asian descent.

Anti-Rust Research

British scientists have just announced an important development in their experiments on the prevention of rust in metals. The discovery has been made at the Department of Scientific and Industrial Research.

During the war a solution of sodium benzoate was used for ensuring that water in car radiators did not freeze in cold weather. It was also found that when added in small proportions to glycerine the mixture so obtained prevented corrosion of metal parts in the engine's cooling system.

It was then applied as an experiment to wrapping materials. Steel specimens so enveloped remained untarnished even when the wrapping was soaked with moisture.

Now a most promising development in these experiments has been disclosed. Sodium benzoate has been added to rubber latex and the resulting solution used for spraying bulky metal articles. These tests proved very satisfactory in giving complete protection from corrosion. Another advantage was that the spray formed a coating which could easily be stripped off when no longer required.

The new liquid preservative will be invaluable for protecting machined metal surfaces against rust during transport or when in storage.

Colorado School of Mines Scholarship

The Government of India have received information regarding the award of a scholar-

ship by the Colorado School of Mines, Golden, Colorado, U. S. A., to enable an Indian student to pursue studies in any of the following subjects: Mining, Metallurgy, Geology, Petroleum production and Petroleum refining, production and utilization of cements, refractories, clays and other non-metallic minerals. The scholarship is awarded annually beginning with the academic year 1949-50.

The scholarship which is renewable upto a maximum period of four years is of the value of \$ 425/- to \$ 475/- per annum which covers all tuition fees. It makes no provision for living or other personal expenses.

Candidates must be *bono fide* residents of India and must possess a good degree in science or engineering from any of the recognised universities in India.

Intending candidates must submit their applications in the prescribed form through their respective universities so as to reach the Ministry of Education, Administration, I North Block, Central Secretariat, New Delhi, by the 30th April, 1949.

Howard Medal—1948

Shri. K. N. Tandon, M.Sc., Research Assistant in the Wood Technology Branch of the Forest Research Institute, Dehra Dun, has been awarded the Howard Medal for 1948 at the annual convocation of the Forest Research Institute and Colleges, presided over by the Hon'ble Pandit Jawharlal Nehru, Prime Minister of India. This award has been made to Shri. K. N. Tandon in recognition of his meritorious and original piece of research work on "The Study of the relation between height and diameter growth in some Indian forest trees".

Indian Chemical Society

The Secretary of the Indian Chemical Society is glad to announce that the Government of West Bengal has made a contribution of a sum of Rupees, five thousand towards the preparation of the History of Chemistry in Ancient and Mediæval India (incorporating Sir P. C. Ray's History of Hindu Chemistry) undertaken by the Society. The Society has also approached the Government of India for a generous contribution for the same purpose.

Zoological Society of Bengal

The Third Annual General Meeting of the Zoological Society of Bengal was held on Sunday, the 27th March 1949, when the Secretary's report for 1948-49 and the audited accounts for 1948 were adopted. In his presidential address Prof. H. K. Mookerjee made a brief survey of zoological researches in the different parts of India and dwelt on the need of extensive and intensive research in various branches of Zoology from the national standpoint. He further laid special stress on the creation of a National Biological Laboratory sponsored by the Govt. of India. Also he appealed to the authorities of the Indian Association for the Cultivation of Science, Calcutta, for inclusion of research in biological sciences as one among its manifold activities of far-reaching importance. The following Office-bearers were elected for 1949-50: *President*: Prof. H. K. Mookerjee, D.Sc. *Vice-Presidents*: Dr. M. O. T. Iyengar, D.Sc., and Mr. K. N. Das, M.Sc. *Treasurer*: Dr. M. M. Chakravarty, D.Sc. *Hony. Secretary*: Mr. G. K. Chakravarty, M.Sc. *Hon. Asst. Secretary*: Mr. A. Guha, B.Sc. *Members*. 1. Dr. S. P. Ray Chaudhuri, Ph.D. 2. Dr. B. S. Chauhan, Ph.D., F.Z.S. 3. Mr. B. K. Mitra, M.Sc., F.Z.S. 4. Mr. J. N. Rudra, M.Sc. 5. Dr. N. G. Basu, M.Sc., M.B.

ERRATA

Vol. XVIII, No. 1, Jan. 1949, page 5, under References:

- (i) For "3. Kalekar, H. M."
- read "3. Kalckar, H. M."
- (ii) For "8. Dounce, A. L., Rothstein, A., Beyer, G. T., Meier, R., and Freer, R. M., *Ibid*"
- read "8. Dounce, A. L., Rothstein, A., Beyer, G. T., Meier, R., and Freer, R. M., *Journ. Biol. Chem.*"

Vol. XVIII, No. 2, Feb. 1949, p. 43, Note on "Berek's Compensator";

Instead of log 14.55 and log 24.95 as given, the values of log $f(14.55^\circ)$ and log $f(24.95^\circ)$ should be calculated from the formula $\log f(i) = \log \{ \sin^2 i (1 + 0.240 \sin^2 i + 0.0627 \sin^4 i) \}$ i being 14.55° and 25.95° .

Vol. XVIII, No. 3, March 1949, p. 74, column 2, line 15.

Note entitled "P-cymene from carenes", for O-derivative read m-derivative.

Indian Association for the Cultivation of Science

CALCUTTA 12

Applications are invited for the post of Professor of Theoretical Physics in the grade Rs. 800—40—1000; 1000—50—1250.

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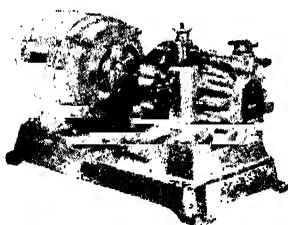
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Current Science



Vol. XVIII]

MAY 1949

[No. 5

	PAGE		PAGE
<i>Indo-Pacific Fisheries Council</i> ..	145	<i>Obituary—Professor Birbal Sahni, F.R.S.</i>	
<i>Eastern Studies at Oxford</i> ..	147	SIR C. V. RAMAN ..	158
<i>The Distribution of Raingauges in the Damodar River Catchment.</i>		SHRI RANJAN ..	158
K. S. RAMAMURTI ..	148	M. O. P. IYENGAR ..	160
<i>Indian Scientists' Tour of Australia</i> ..	150	A. R. RAO ..	162
<i>Sweet Potatoes (Ipomoea batatas).—</i>		T. S. SADASIVAN ..	164
B. SEN ..	152	<i>Letters to the Editor</i> ..	166
<i>Science and Religion</i> ..	154	<i>Courses on Indian Philosophy at Asia Institute in New York</i> ..	182
<i>Metabolic Mechanisms of Unstriated Muscle.</i> SUNITA INDERJIT SINGH AND INDERJIT SINGH ..	155	<i>Reviews</i> ..	183
<i>In Memoriam—Thomas Nelson Annandale.</i>		<i>Ghee—Its Production and Marketing</i> ..	188
S. L. HORA ..	157	<i>Science Notes and News</i> ..	190

INDO-PACIFIC FISHERIES COUNCIL

THE work of the International Council for the Exploration of the Sea established at Copenhagen, Denmark, in 1899, for starting and co-ordinating detailed programmes of research and investigations on multifarious hydrological and biological problems in the waters of the Arctic Ocean and the North and Baltic Seas by nations interested in the fisheries of this vast area, not only proved the value of such international co-operative work, but also evolved the pattern for carrying out such developmental projects on a regional basis not circumscribed by artificial national boundaries. The Fisheries Committee of the F.A.O. in its first two sessions at Quebec and Copenhagen in 1945 and 1946 considered in detail the questions connected with the development of the

fishery resources of under-developed areas, such as, South East Asia, Southern Pacific, etc. Definite plans for starting Regional Fisheries Councils for such areas were formulated in the meeting of the U.N.R.R.A. workers in Australia in 1946 and in the Fisheries Meeting held at Singapore in January 1947 under the ægis of the Special Commissioner for South East Asia. As a result, an Agreement was drawn up by the Governments of Burma, China, France, India, the Netherlands, the Philippines, the United Kingdom and the United States of America in a meeting convened by F.A.O. at Baguio in Philippines in February 1948 for the establishment of an Indo-Pacific Fisheries Council, which would co-ordinate and plan programmes for the development and proper

utilization of the aquatic resources of the Indo-Pacific area. In accordance with the terms of the Agreement, the Indo-Pacific Fisheries Council came into existence in November 1948, when information regarding ratification of the Agreement by five of the member nations was received by the Director-General of the F.A.O. Since then the Agreement has been accepted by seven more Governments.

The first session of this Council was inaugurated by the Hon'ble Mr. Norris E. Dodd, Director-General of the F.A.O., at Singapore, on the 24th of March 1949, and the session continued till 31st of March. In this inaugural session the main work of the Council consisted in establishing the basis of a programme of international collaboration in connection with research and exploration of the aquatic resources of this vast area. The session was attended by delegates of 9 member countries, *viz.*, Australia, Ceylon, China, French Indo-China, India, the Netherlands, the Philippines, the United Kingdom and the United States of America, while official observers on behalf of Korea, UNESCO, SCAP and Southern Pacific Commission also attended the meetings.

Active work in connection with the organization of the Council had been carried on since the Fisheries Meeting in Singapore in January 1947; information and views had been exchanged between various countries; some data had been collected; papers prepared; and a number of informal meetings held. All this work had built up an understanding of the ways in which international collaboration would be useful and where it would be possible. All the same, the delegates came with open minds and often with very varying ideas. Although the Baguio Agreement had provided the main lines of the plan of organization for the Council, it was found necessary to discuss this plan in great detail, and to lay down the Rules of Procedure for the Council. This work, which was completed at the inaugural meeting, may be regarded as one of the principal results of the

meeting. It is proposed to hold regularly an annual meeting of the Council at a place to be decided on by the Council, but special meetings to be called either at the direction of the Council, or of the Executive Committee with the approval of a majority of the member governments or at the request of a majority of the member government themselves are also provided under the Rules. In between the annual sessions, the work of the Council will be carried on by an Executive Committee consisting of a Chairman, a Vice-Chairman, and the Secretary. The Secretary is the F.A.O. Regional Representative for Fisheries in the Far East, and the necessary finance and secretariat assistance is being provided by the F.A.O. For carrying out the technical work of the Council, two Technical Committees with well-defined terms of reference relating to specific problems in Biology and Hydrology on the one hand and Technology of the craft and gear, efficient distribution of catches and the economics of the industry on the other have been set up. These Committees met a number of times and drew up a number of realistic programmes of work. This will be clear from the terms of reference of the two Committees as outlined below:—

1. The Committee on Hydrology and Biology will deal with specific problems of the development and proper utilization of the fishery resources and *inter alia* will be concerned with (1) the aquatic biosphere, and the physical and chemical phenomena concerned with the proper understanding thereof; (2) identification and description of the natural units of the stocks of aquatic organisms; (3) migratory, feeding and reproductive habits; (4) rates and causes of recruitment, growth and mortality; (5) the measurement and analysis of population levels and their fluctuations and the effect of fishing operations thereon and (6) increasing fish-cultural production through the development and application of biological techniques.

2. The Committee on Technology will deal with specific problems on the development and proper utilization of the fisheries with special reference to (1) the capture, preservation, processing, distribution, marketing, and consumption of fish and fishery products; (2) fish-pond engineering and management; (3) statistics; (4) equipment, facilities and techniques; and (5) economic factors such as financing and manpower.

These Committees will prepare detailed reports on the national programmes now being followed by various member countries in their respective areas, and suggest for the consideration of the Council at its next session, parts of such programmes as could best be carried out by various member nations with a view to conserving resources and achieving results at the earliest possible date.

During the plenary sessions of the Council, 15 technical papers dealing with such varied subjects as hydrology, biology, habits and food of fishes, fish culture, refrigeration, processing of fish, preparation of oils and bye-products, assessment of stocks and economics of the industry were read and discussed. A symposium on Pelagic Fisheries, to which a number of papers were contributed by the delegations from India, United States of America, Netherlands and Australia was held in three after-dinner meetings.

Special excursions were arranged for the delegates to study types of fishing methods and fish-culture practices in the Singapore area. A film on methods of Hydrological Research with a commentary by Dr. H. Thompson of Australia was shown, and specimens of the important food fishes of Malaya with photographs of the fish and the fishing methods were exhibited.

The Executive Committee during the first year will have as its members:—

Dr. Baini Prashad (India)—*Chairman*.

Dr. J. F. D. Hardenberg (Netherlands)

—*Vice-Chairman*.

Dr. G. L. Kesteven (F.A.O. Regional Representative for Fisheries)

—*Secretary*.

The following were elected Office-bearers of the two Technical Committees:—

1. *Hydrology and Biology*:—

Dr. N. K. Panikkar (India)

—*Chairman*.

Mr. W. H. Schuster (Netherlands)

—*Rapporteur*.

2. *Technology*:—

Dr. C. Amirthalingam (Ceylon)

—*Chairman*.

Mr. Claro Martin (Philippines)

—*Rapporteur*.

An invitation was received from the Government of Australia for the Council to hold its 1950 session in Australia, and it is very likely that this invitation will be accepted.

EASTERN STUDIES AT OXFORD

OXFORD University has approved a statute making permanent the Spalding Professorship of Eastern Religions and Ethics and expressed gratitude to the benefactors, Mr. and Mrs. K. N. Spalding, whose new gift of £ 42,000 had made this possible.

This particular Chair was first established for a provisional period in 1935 and has been held since then by Dr. S. Radhakrishnan, who is a Fellow of All Souls College, Oxford, and has been Vice-Chancellor of Andhra and

Benares Universities and is recognised as one of the greatest Asian educationists.

He is at present Chairman of the Executive Board of UNESCO and of the Indian Universities Commission recently appointed by the Indian Government.

The new statute making the endowment of the Chair permanent reiterates the desire of the founders to promote closer understanding between the world's great religions and makes it clear that the intention is normally to appoint an Asian in the Chair.

THE DISTRIBUTION OF RAINGAUGES IN THE DAMODAR RIVER CATCHMENT

K. S. RAMAMURTI

(Poona)

A GOOD estimate of the probable discharge of a river is essential for designing any project to harness its water resources. Since the discharge is calculated from the total quantity of water that has fallen as rain in the catchment, it is essential that the number and location of the raingauge stations in the catchment should be so designed as to give the best estimate of the average rainfall in the area. The total quantity of water would then be the average rainfall of the stations in the area multiplied by the area of the catchment.

It was pointed out in a previous note¹ that a non-uniform distribution will give a higher weightage to the rainfall recorded in the regions with a denser distribution of raingauges and less weightage to that in the regions with sparser distribution. For example, the average normal rainfall during June to September over Hyderabad State calculated as the average of the rainfall recorded at different number of raingauge stations has been worked out and compared with the weighted mean calculated on the assumption that all the districts have approximately equal areas. Even if the areas are not equal, it is always possible to allot to each district mean an average area from or including the district. The normal rainfall data of Hyderabad stations have been taken from the *Memoirs of the Indian Meteorological Department*, Vol. 27, Part 5.

- | | |
|--|----------|
| 1. Average of 20 stations that have records from dates prior to 1920 | .. 25.9" |
| 2. Average of 65 stations that exist now | .. 27.7" |
| 3. Average of 45 newly added stations | .. 29.7" |
| 4. Average of 31 of these newly added stations which are situated in the Godavari basin in the northern part of Hyderabad where the rainfall is comparatively more | .. 33.6" |
| 5. Average of 17 stations chosen one in each district | .. 26.3" |
| 6. Average of the district means | .. 26.6" |

The district means are calculated as the average of all the stations in the district.

Assuming that the areas of all the districts are equal, the average of the district means will be the weighted average and hence may be taken to be a good estimate of the average normal rainfall over the State. It will be seen that the average normal rainfall calculated from the 17 evenly distributed stations, one in each district, gives almost as good an estimate. The difference is only 0.3 in., about 1% of the weighted average. The average of 65 stations is too high by 1.1 in.; that of 45 newly added stations by 3.1 in., and that of 31 new stations by as much as 7.0 in. Therefore it is evident that an increase in the number of raingauge stations does not necessarily give a more accurate estimate of the average rainfall.

In the following note it is proposed to consider the number and the distribution of raingauges necessary in the Damodar river catchment so that an unbiased estimate of the average rainfall may be arrived at with a reasonably small standard error. That the distribution of raingauges should be uniform is brought out in the following analysis also.

The Damodar river* rises in the hills of Chota Nagpur and flows in a generally southeasterly direction till it changes its course abruptly to a southerly direction below Raniganj. Its principal tributary stream is the Barakar river. The origin of the river is approximately at 2,000 feet above mean sea-level. At the point of junction of its two prongs on the western border of Hazaribagh district, the united stream starts at an elevation of 1,326 feet above mean sea-level; but in its course of 93 miles through Hazaribagh district, its fall averages 8 feet per mile and leaves the district with an elevation of only 582 feet.

The above description of the course of the river gives also an idea of the ruggedness of the basin.

Rainfall data are available for 22 stations in the Damodar river catchment down to Asansol from the year 1923 onwards. The figure below shows the catchment area, the location of the raingauges and the normal

* Vide *The Imperial Gazetteer of India*, 1908, 11, 132-33.

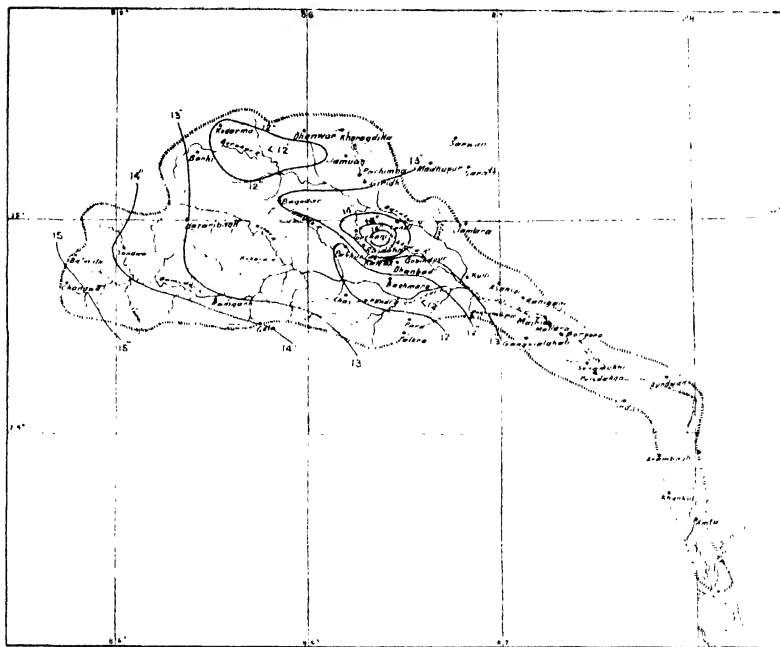


FIG. 1. Catchment of the Damodar river
Normal rainfall in July

isohyets for July. July rainfall of these stations for the years 1923 to 1940 have been used in the following analysis.

*Analysis of variance of the rainfall
during July for the years 1923 to 1940 in
the Damodar river catchment*

S. S. due to	D.F.	S.S.	Mean S.S.	F.
Year ..	17	4,219.70	248.2176	18.2214*
Space ..	21	962.32	45.8247	3.3639*
Residual ..	357	4,863.18	13.6223	
Total ..	395	10,045.20		

* Significant at 0.1% level

Note.—S.S.—sum of squares, D.F.—degrees of freedom, F.—variance ratio.

The variance due to years as well as that due to space are significant. That is, the variation of rainfall from year to year as well as the variation due to orography are significantly more than the residual variation. Now let us consider the best design for sampling rainfall in space. The intra-class correlation coefficient, ρ is equal to

$\frac{M_x - M}{M_x + (n-1)M}$, where M_x is the unbiased

estimate of variance or the random variation present in the material sampled, M is the variation within the sample or the systematic variance, and n the number in the sample. Since $M_x > M$, ρ is negative and significant. Madow and Madow (1944) have shown that if the serial correlations have a negative sum, systematic sampling is better than random sampling. It is also shown that the sum of the serial correlations is $(n-1)\rho$. Since ρ is negative in the case of spatial distribution of rainfall in the Damodar river catchment, a better unbiased estimate of the average rainfall could be got by employing systematic sampling design than random sampling design. The variance of the mean is given by

$$\sigma_x^2 = \frac{\sigma^2}{n} \{1 + (n-1)\rho\},$$

where σ is the standard deviation of any observation.

Therefore systematic sampling design, which was already suggested on the basis of computational convenience,¹ and found to be good in estimating the average normal rainfall of Hyderabad State, is better than random sampling design in the case of collection of rainfall data, as rainfall is generally

subject to certain systematic influences like lateral instability of the atmosphere, orography, etc.

The 22 stations in the catchment have been ranked according to the normal rainfall and were grouped into two samples by taking all the stations with odd ranks to form one sample and the rest another. The sample variance was calculated from each year's data. The 18 separate estimates of the between-sample variance thus calculated were tested for homogeneity by Bartlett's (1937) test. $-2 \log \mu$ works out to be 15.4838 and C the corrective factor is 1.35. For 17 degrees of freedom $-2 \log \mu$ is not significant at 50% level and the corrected value of it is not significant even at 90% level. Therefore, despite the fact that these individual variances are based on a single degree of freedom, it may be concluded that these are homogeneous. That is, the residual variance is due to chance causes which are independent of time and space effects. The pooled sum of squares of the 18 separate estimates, each with a single degree of freedom, is 9.932. The error variance has been estimated to be 13.623 based on 357 degrees of freedom (refer table). The value of F for these two estimates is 1.372. Hence the two estimates are not significantly different and we may assume 13.6223 to be the error variance of any observation.

The error variance of the average rainfall in the catchment based on 22 raingauge sta-

tions is therefore 0.6192 and the standard error 0.79 inch, which is 6% of the average normal rainfall (13.31 inches) in the catchment. Therefore, if the 22 stations are distributed evenly in the catchment, the average of these stations will be an unbiased estimate of the average rainfall in the catchment with a standard error of 6%. And this much accuracy is fairly sufficient for all practical purposes. It may also be mentioned that the distribution of raingauges in the Damodar river catchment is fairly uniform but for a small cluster of stations around Topchanchi (see fig.).

Though only the total rainfall of July has been used in the above analysis, it is felt that the results will be applicable to the total rainfall of a smaller number of days as well and that the 22 stations may be sufficient to calculate the average rainfall due to a storm, etc. However a verification is necessary.

The author is thankful to Dr. S. K. Banerji and Dr. W. F. Kibble for kindly going through the manuscript.

1. Ramamurti, K. S., "On estimating the average depth of rainfall over an area and the distribution of raingauges," *Curr. Sci.*, 1948, **17**, 317-18.
2. Madow, William, G., and Lillian H. Madow, "On the theory of systematic sampling, I," *Annals of Math. Stat.*, 1944, **15**, 1-24.
3. Bartlett, M. S., "Properties of sufficiency and statistical tests," *Proc. Roy. Soc., London*, 1937, **160A**, 268-82.

INDIAN SCIENTISTS' TOUR OF AUSTRALIA

KEEN interest in the scope of scientific investigation in Australia and in the facilities available for modern research, was shown by the four members of the Indian Scientists delegation who have just returned after completing their tour of Australia.

The tour was arranged by the Australian Council for Scientific and Industrial Research, a government authority organised on somewhat the same plan as the Indian Council with a central authority, and sections in the provinces.

The leader of the delegation, Dr. S. Krishna, C.I.E. Ph.D., D.Sc., F.I.C., F.A.Sc., Director of Forest Products Research, Forest Research Institute at Dehra Dun, and a foundation member of the National Institute of Sciences, represented India at the Fifth Empire Forestry Conference in London in 1947.

Another member, Dr. D. P. Pal, M.Sc., Ph.D., F.L.S., F.N.I., joint Director of the Agricultural Research Institute, is specially interested in the breeding and genetics of wheat, potatoes and tobacco.

Representative of Indian medical research was Lieutenant-Colonel M. L. Ahuja, M.B., Ch.B., M.D., D.P.H., Director of the Central Research Institute, Kasauli, and a member of the governing body and the scientific advisory body of the Indian CSIR.

The fourth member, Mr. V. P. Sondhi, M.B.E., M.Sc., F.G.S., F.N.I., is Deputy-Director of Geological Survey, New Delhi.

Visit to Canberra

On arrival at Darwin, Northern Territory, the scientists flew over the northern State of Queensland from Darwin, in Central Australia, to Brisbane and on February 21 they arrived in Sydney.

At Canberra, the national capital, the visitors inspected CSIR laboratories and were received by the Governor-General of Australia, the Rt.-Hon. W. J. McKell. They met also the Prime Minister, the Rt.-Hon. J. B. Chifley, and were impressed by the friendly personalities of both the Governor-General and the Prime Minister.

The scientists attended a reception given by the High Commissioner for India, Lieutenant-Colonel D. S. Bedi, to the Australian Minister for External Affairs, Dr. H. V. Evatt. Among places visited in the national capital were the Commonwealth Forestry and Timber Bureau, the Australian Institute of Anatomy and the Commonwealth Observatory at Mount Stromlo.

Irrigation Areas

Travelling by air, the delegation then visited the irrigation areas on the Murrumbidgee River at Leeton and Griffith, in the State of New South Wales. There they saw farms on which rice and wheat are grown.

The visitors were very interested in the emus and kangaroos of which they obtained their first view as the delegation travelled through the countryside.

At Boonoke station, in the Deniliquin district of Riverina, the visitors were able to inspect Australia's most famous Merino stud. About 70,000 sheep are run on the property. At the stud they were shown 25 rams each worth more than Rs. 10,660.

The delegation passed through Echuca a Murray River township in the State of Victoria which is a centre of dairying and wheat growing. At Shepperton, in the Goulburn Valley, they inspected the extensive fruit-growing areas which support the biggest fruit canneries in Australia.

At a Press conference in Melbourne, they pointed out that the great Australian wheat research authority, William Farrer, had used Indian varieties of wheat in the course of his breeding experiments, and that some of the Indian strains exist in Australian wheatfields to-day.

Forestry Research

Because of the nature of the work carried out at the Forest Research Institute at Dehra Dun, Dr. Krishna found his main interest in Melbourne in the activities of CSIR's Forest Products Division. Its modern laboratories conduct research into matters relating to timber and the utilisation of forest

products generally. Dr. Krishna showed keen interest in the work of the various sections, which are devoted to wood structure, wood chemistry, timber physics, and mechanics, seasoning, preservation, veneer and gluing, and utilisation of timber products.

At the University of Melbourne Dr. Pal renewed acquaintances with former students who are studying in Australia, and inspected the laboratories of the Physics School.

Mr. Sondhi was received by the Director of Commonwealth Bureau of Mineral Resources, Dr. H. G. Ragett, and inspected the maps and technical records and mineral specimens at the Bureau.

Medical Institute

Lieutenant-Colonel Ahuja was particularly interested in the medical research work carried out by the Walter and Eliza Hall Institute, which is world famous for investigations into the problems of pathology and medicine. The Institute is directed by Professor F. M. Burnett, F.R.S., and Ph.D. (London). Important activities undertaken at the Institute include large-scale production of influenza virus vaccine, study of snake-bite and virus diseases of man and animal and the chemical detection of poisons.

On March 2 the scientists flew to Hobart, capital of Australia's island State of Tasmania where they visited the University of Tasmania, and inspected the State's hydro-electric power stations. They returned to Melbourne on March 6.

Brown Coal and Paper

By motor car from Melbourne the delegation was taken to Yallourn and Maryvale. At Yallourn the world's biggest known brown coal deposits are used by the Victorian State Electricity Commission in its extensive electric power plant which serves the City of Melbourne. At Maryvale, the scientists visited the Australian Paper Mills, one of the largest companies in the industry and were interested in the process by which brown paper is manufactured from fire-charred timber.

Lectures were given to the Australian Chemical Institute by Dr. Krishna and at the Melbourne University, by Dr. Pal.

Before returning to India, the scientists visited also Perth, Adelaide, Brisbane, Newcastle and Sydney.

SWEET POTATOES (*IPOMOEA BATATAS*)

B. SEN

(Vivekananda Laboratory, Almora, U.P.)

INTRODUCTION

IN India sweet potato is commonly looked upon as an inferior food crop. In spite of the fact that sweet potato can help in a great measure to relieve our acute shortage of both food and fodder, up to this time it has not attracted the attention it deserves.

Even in the U.S.A., the increased interest in sweet potato is of comparatively recent origin. It was the demand of the Army for dehydrated food during World War II, and

machines can be utilised with profit. Experimental trials in India have shown that 20% of sweet potato flour, or even more, can be mixed with *atta* for chapattis. The result is both nutritious and palatable.

Apart from the higher yield of the edible roots of sweet potato, as compared with ordinary potato, the vine terminals and leaves constitute an excellent source of fodder. Nearly 1¼ tons of high quality dried sweet potato leaf meal can be obtained per acre. The feed value is approxi-

TABLE I

Composition of food (edible portion in one pound)

	Calories	Protein	Fat	Carbohydrates	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	gm.	gm.	mg.	mg.		mg.	mg.	mg.	mg.
Sweet potatoes	567	8	3	127	159	222	3.2	17,200	.45	.32	5.9	113
Irish potatoes	386	9	.5	87	36	222	3.4	180	.41	.23	5.4	45

stoppage of normal imports from abroad of root starch, which brought out the importance of sweet potato in the U.S.A. By 1945, the total value of the U.S.A. sweet potato crop was of the order of Rs. 44 crores.

Dr. Julian C. Miller of Baton Rouge, Louisiana, has estimated the comparative nutritive values of edible portions of ordinary white potato and sweet potato. His unpublished data is produced in Table I.

It will be seen from the above table that sweet potato ranks higher than ordinary potato in most categories, particularly in carbohydrates, calcium and vitamin A. Moreover, the yield of sweet potato per acre has been found to be higher than that of ordinary potato. Tender end-lengths of sweet potato vines can also be used as a table spinach. A few plants would be sufficient to supply the spinach requirements of a family for a whole season. Small samples of sweet potatoes can easily be sun-dried by the cultivators and made into flour for their own use, as is now commonly done in villages in India where sweet potatoes are cultivated. For handling large quantities, modern dehydrating

mately equal to that of alfalfa hay, as will be seen from the unpublished data of Dr. Julian C. Miller in Table II.

TABLE II

	Protein	Fats	Carbohydrates	Mineral Matter
Sweet potato leaves and terminals	12.6%	3.5%	45.5%	10.2%
Alfalfa hay	14.7%	2.0%	36.4%	8.3%

Thus the roots and tender vine end-lengths of sweet potato offer a very nutritious food for human beings, and the stringy roots and the bulk of the stems and leaves make an excellent fodder for cattle.

Sweet potato also has a number of important industrial uses: it can be utilised for the manufacture of starch, industrial alcohol, pectin, carotene and syrup.

EXPERIMENTS

Through the courtesy of Dr. Julian C. Miller of Baton Rouge and Dr. C. E. Steinbaur of Beltsville, Maryland, I obtained two roots each of 14 strains of high yielding and disease-resistant sweet potato. Roots of two strains of Bengal sweet potato

and cuttings of two strains of Bombay sweet potato were also obtained for comparative trial. All these were planted in Almora on March 21st, 1948. On account of the limited number of cuttings of each strain available at any sowing date, a properly replicated experiment could not be undertaken in 1948. Sowings were continued from May 1st to June 26th, 1948. Each strain was planted in a separate plot—10' x 10'. The distance between rows was 3' and between plants 12". For root multiplication, a very late sowing was undertaken on July 8th, 1948, at the U.P. Government Farm at Hawalbagh. The weights of the roots and of the tops (vines and leaves) of each row were recorded at harvest time. From the nature of these preliminary experiments no exact estimate of the comparative yield of the different strains is justified.

of 220 mds. from the strain Essex. On the other hand, the highest yield of sweet potato was of the order of 435 mds. from the Bengal White variety, and 388 mds. from the U.S.A. Nancy Hall. (Photographs of roots of some of the strains are given in Fig. 1). Obviously, the yield figures given in Table III are not likely to be obtained by the cultivators, until adequate facilities become available for improving their cultural practices. Under similar cultural conditions, however, not only will the yield of the more nutritious sweet potato be higher than that of ordinary potato, but the supply of much needed fodder will be an additional gain. The fresh weights of the tops of different strains of sweet potato as indicated in Table III show that it might even pay us to grow sweet potato on a large scale for fodder alone. From the records of the yield of roots from rows



Nancy Hall
(High yield and high carotene content)



Ranger
(High yield and high carotene content)



Triumph
(High yield and high starch content)



Bengal White
(High yield with high moisture)

FIG. 1

Compared to the yield of the ordinary potato, the yield of sweet potato is much higher. For instance, in a sowing of February 1948, of several strains of U.S.A. ordinary potatoes, the highest yield calculated on an acreage basis was of the order

planted at different dates, it was found that the yields from the first rows of the different strains were invariably higher than those from the latest plantings of the cuttings in the third rows. The yield of Orange Little Stem and of B. 4306, planted on

June 25th, and of M. 4, planted on July 6th, was poor, and yields of all strains planted at Hawalbagh on July 8th were much lower compared to the yields obtained from the earlier sowings in Almora (Table III).

TABLE III

Showing yield, calculated on acreage basis, of roots and tops of different strains of sweet potato observed in Almora and Hawalbagh

Strain	Roots		Tops	
	at Almora	at Hawalbagh	at Almora	at Hawalbagh
	Mds.	Mds.	Mds.	Mds.
1 Unit I ..	148	121	494	346
2 Nancy Hall ..	388	119	180	318
3 Triumph ..	347	120	268	166
4 Ranger ..	302	112	501	166
5 B-196 ..	291	208	451	194
6 B-219 ..	322	82	100	304
7 B-4004 ..	294	214	440	97
8 B-4306 ..	79	52	509	581
9 B-5941 ..	313	..	175	..
10 Yellow Jersey ..	235	113	196	137
11 Jersey Big Stem ..	289	92	324	28
12 Pelican Processor ..	289	..	201	..
13 Orange Little Stem ..	99	..	..	..
14 Bengal White ..	436	201	345	189
15 M. 4 ..	126	..	319	..
16 Bengal Purple ..	301	..	411	..

To find out the strains best suited for any

given region, properly planned co-ordinated sowings should be undertaken in different regions with all available strains of sweet potato, both Indian and foreign. This is essential because the yield and the quality of the roots will depend not only on the strain, but also on the climatic factors of different regions. From a series of plantings at different dates, the best sowing date for a particular region has also to be determined, because the yield and the quality of the roots vary according to the date of planting. For instance, in Almora, the Bengal White variety gave the highest yield; while in Hawalbagh, U.S.A. strains B. 4004 and B. 196 gave yields higher than that of Bengal White. On the other hand, we found that the moisture content of roots of Bengal White was 83%, whereas that of Nancy Hall was 69% and of Triumph 63%. Therefore, on the basis of solids, the yield per acre of Bengal White was 74.46 mds., compared to 120.28 mds. for Nancy Hall and 128 mds. for Triumph.

I take this opportunity to acknowledge the help of all members of the staff of this Laboratory, particularly of Shri Tara Datt Pant in the supervision of the field work, and of Shri Shankar Lal Sah in the despatch of 32,000 vine cuttings, sent on request to different provinces. The expenses of this preliminary work were met from financial aid received from Shri Charat Ram, New Delhi.

A detailed paper on this subject is in the press.

SCIENCE AND RELIGION

IN a lecture on "Science and Religion" given under the auspices of the Catholic Action Association, Delhi, Dr. Wolsky of the UNESCO expressed the view that due to the particular method of scientific research there were limitations on scientific knowledge. Whilst scientists study natural phenomena by measuring them they do not tell us anything about essence and existence, about the value and final explanation of life, matter, energy, of heaven and earth. These problems cannot be measured by measurements. All what Science can do is to give us a picture of the world and the universe. To form an opinion about the meaning and value of this picture, to arrive at a firm religion is left to him who sees the picture as a whole and not only its details. This he is able to do as a

free human being and aided by God's grace. Now the scientist who has the desire to form views on the essence and value of things must be aware that whilst he is forming these views he is no longer acting as a scientist but simply as a man using his mental faculties according to the general rules of logic for approaching religious truth. He must deliberately abandon his particular methods of science which are utterly unsuitable in dealing with the fundamental problems of philosophy and religion. He is now no longer a scientist and his approach cannot be scientific. When he comes to deal with the most fundamental problems of humanity, he is in a particularly more difficult position than other men of learning, e.g., those employed in the humanities or in arts or letters. This is perhaps the real source

of the mechanistic, materialistic tendencies of certain scientists expressed in the Latin proverb "tres physici, duo athei," i.e., out of 3 scientists 2 are atheists. This attitude leads one to formulate a scientific philosophy, a religion without revelation. These bear an innate contradiction in themselves, for science and philosophy and religion rest on different mental attitudes.

Recently, according to press reports, a leader of the Radical Democratic Party had accused Modern science, especially in supposed findings of 20th century Physics of giving birth to what he called a religious revivalism and a kind of neo-mysticism. The lecturer wished to assure the leader and those who may share his opinion that scientists in our days and especially religious scientists including Catholics do not intend to spread any sort of scientific mysticism as in their own interest of their own religious beliefs they just want to keep their scientific activities free from any non-scientific elements.

Scientists like J. Jeans who expressed the view that there is a supreme intellect beyond the universe were doing so not as scientific but as thinking men, free to ex-

press their views. They of course based their considerations on real scientific findings. These findings however give only the background picture. The comments were made by the spectators, Jeans, Eddington, etc. not with scientific methods but with philosophical or theological reflections. Scientists like Haldane, Hogben and Prenant expressed views contrary to the Christian religion. Whilst they may be free to hold them, these anti-religious views are just as non-scientific as the so-called religious revivalism and neo-mysticism of Jeans, etc.

There was a danger to-day, said Dr. Wolsky, of politically controlled science but in an atmosphere of free science one need have no fear. If properly pursued it can never interfere with religion. Similarly. Catholic religious truth has its proper domain. All we want is to expose it clearly and explain it to the modern mind and to the millions who never had the chance to hear about it. We need freedom and tolerance. If this is granted, science and religion will strive side by side as parallel paths of truth which like parallels according to the Euclidean postulate meet in the Infinite, in the eternal truth of God.

METABOLIC MECHANISMS OF UNSTRIATED MUSCLE

SUNITA INDERJIT SINGH AND INDERJIT SINGH

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THERE are several metabolic mechanisms in unstriated muscle as shown by the effect of asphyxia, glucose, iodoacetic acid, etc., on the mechanical response of unstriated muscle.

Anaerobic mechanisms. When unstriated muscle from frog's or dog's stomach is asphyxiated, there is a stage of hyperexcitability before the response declines. This effects the response to alternating and direct currents, acetylcholine, potassium and tone. Tone may thus increase immediately on asphyxiation; this has to be distinguished from the later increase of tone.^{1, 2}

The asphyxial excitability is of two kinds. One kind is increased by iodoacetic acid and depressed by glucose (0.1-0.2 p.c.); removal of glucose enhances the effect of asphyxia. This resembles the asphyxial hyperexcitability in the central nervous system which is increased by hypoglycaemia.³ The second kind of asphyxial hyperexcitability is increased by glucose and depressed by iodoacetic acid as happens in the carotid body.³ These two mechanisms are therefore antagonistic.

The inhibitory action of glucose on one kind of asphyxial hyperexcitability is succeeded by an opposite action, both these actions being abolished by iodoacetic acid. This indicates that the glycolytic mechanism at first suppresses the nonglycolytic one and then takes over from the latter.

The anaerobic utilisation of glucose appears to happen in two ways. When glucose is added to an asphyxiated muscle, there may be an immediate increase in response followed by a decline to a steady state or the response increases gradually to that state. There are two possible explanations for this. The first explanation is that the hyperexcitability on addition of glucose may be due to a substance, which is metabolised with glucose, but is soon exhausted. The second explanation is that asphyxia renders the muscle more sensitive to the action of glucose, this being due to the opening of reserve channels for its utilisation. This second explanation is supported by two facts. First, the inhibitory effect of oxygen on asphyxial hyperexcitability in glucose is readily shown. Secondly, iodoacetic may

at first increase the response.⁴ The opening of reserve channels of metabolism probably accounts for the asphyxial hyperexcitability.

Tone producing substances relieve asphyxial arrest^{1,2}. This action is antagonised by glucose, indicating that the above substances release a nonglycolytic mechanism. Tone producing substances may also hasten asphyxial arrest; it is presumed therefore, the suppressed mechanism is a glycolytic one. In the brain potassium suppresses the formation of lactic acid during asphyxia.³

There is a glycolytic mechanism in acid solutions as shown by relief of asphyxial arrest by glucose. There is also a nonglycolytic mechanism for acid solutions as shown by the functioning of the muscle in the presence of iodoacetic acid^{1,2}. The mechanism for acid solutions is not the same as that for alkaline solutions, as shown by the fact that asphyxial arrest is relieved by change of reaction. This can be done alternately several times, suggesting that the alkaline mechanism rests in acid solutions and *vice versa*. Ordinarily in an asphyxiated muscle poisoned with iodoacetic acid no recovery takes place unless oxygen is admitted. Iodoacetic acid diminishes but does not abolish the response on change of reaction, suggesting that rest only partly accounts for the recovery on change of reaction. Change of reaction has thus also a stimulating effect due to its tone producing properties. Glucose has an inhibitory effect also in acid solutions, showing that the glycolytic mechanism for acid solutions is antagonistic to the nonglycolytic one.

Aerobic mechanisms. Cyanide does not entirely abolish activity, which is further decreased by stoppage of oxygen supply, indicating that there are two aerobic systems, one involving cytochrome and the other involving a cyanide resistant substance, possibly a resistant cytochrome. The aerobic mechanisms are also divided into glycolytic and nonglycolytic which are antagonistic as shown by the inhibitory effect of glucose. Both the aerobic systems are antagonistic to the anaerobic ones as shown by the inhibitory effect of oxygen^{1,2}. Sodium lactate and salts of fatty acids, such as sodium acetate, propionate, butyrate improve the response suggesting their utilisation². After asphyxiation the muscle becomes more sensitive to oxygen indicating opening of reserve oxidative channels.

Inhibition. The responses of unstriated muscle are divided into two classes, inhibi-

tion and contraction^{4,5,6,7}. That inhibition is active is shown by increase in oxygen consumption,⁹ and its abolition by asphyxia and restoration by glucose. The anaerobic mechanism for inhibition is antagonistic to that for contraction as shown by the fact that asphyxia while decreasing inhibition may increase contraction. The aerobic mechanisms for both may also be antagonistic as shown by the fact that after asphyxiation, oxygen may increase tone, but diminish inhibition. Both inhibition and contraction may be subserved by the same mechanism aerobically as well as anaerobically, as shown by the identical effect of glucose in asphyxia and oxygen subsequently. The aerobic mechanism for inhibition may be antagonistic to the anaerobic one, as shown by the inhibitory effect of oxygen.

That relaxation of muscle may also be passive is shown by decrease in oxygen consumption of the relaxed muscle⁹, and absence of *rigor mortis*.

Contraction. The contractions of unstriated muscle are divided into four groups as produced by nervous stimulation, electric current, drugs such as adrenaline and acetylcholine and ions such as potassium and barium. Their susceptibility to asphyxia suggests that they are subserved by different metabolic mechanisms^{1,3}. Thus the susceptibility to asphyxia varies in the following order:—Nervous stimulation > electric current > drugs > ions.

The aerobic mechanisms of twitch and tone may be different^{1,2}; this is shown by the fact that after asphyxiation, introduction of oxygen may increase tone and decrease twitch or they may be subserved by a common mechanism. The anaerobic mechanism for tone and twitch may be different as suggested by the following experiments: (1) addition of glucose to an asphyxiated muscle may increase tone and decrease twitch, (2) asphyxia may increase twitch though tone may be unaffected or actually decrease.

Though there are several metabolic mechanisms in unstriated muscle, they appear to be related and the metabolic compartments are not watertight. Thus oxygen may not have an inhibitory effect after asphyxia suggesting that the anaerobic mechanism functions aerobically also. Similarly both tone and twitch may be simultaneously increased by oxygen or glucose. The antagonism between the various metabolic mechanisms prevents utilisation of energy simultaneously from

two sources. When one source is opened, the other is closed, thus exercising economy in the expenditure of energy.

1. Singh, I., and Singh, S. I., *Curr. Sci.*, 1947, **16**, 259. 2. —, *Proc. Ind. Acad. Sci.*, 1948, **27**, 127. 3. Best and Taylor, *The Physiological*

Basis of Medical Practice, London, 1945. 4. Singh, I., *J. Physiol.*, 1938, **92**, 62. 5. —, *Ibid.*, 1939, **96**, 367. 6. —, *Ibid.*, 1940, **98**, 155. 7. —, *Ind. Journ. Med. Res.*, 1942, **30**, 629. 8. —, and Singh, S. I., *Proc. Ind. Acad. Sci.*, 1943, **28**, 51. 9. Rao, M. S., and Singh, I., *J. Physiol.*, 1940, **98**, 12.

IN MEMORIAM¹

THOMAS NELSON ANNANDALE

ON the 10th April 1949, some past and present members of the Zoological Survey of India assembled at the Scottish Cemetery, Calcutta, to pay their respectful homage to the sad and loving memory of Dr. Thomas Nelson Annandale, the founder-Director of the Survey, who died on the 10th April 1924, twenty-five years ago. Wreaths, flower bunches and loose flowers were laid on the grave and those present stood in silence for some time remembering his brilliant career in India, his erudite learning, his love for the staff and his manifold kindnesses and courtesies to many. It was decided by those, who knew Annandale personally, that every year on this day they should assemble and pay their homage to his memory with floral tributes.

The Royal Asiatic Society of Bengal, with which he was closely associated throughout his period of service in India as Anthropological Secretary, Vice-President, and as its President in 1923, perpetuates his memory by a triennial award of the Annandale Memorial Medal on a person who has made the most important contribution, during the previous five years, to Anthropology in Asia and the first award was made of Dr. Fritz Sarasin in 1928 in honour to Dr. Annandale's lifework in physical anthropology. Thereafter the award has been made alternately for physical and cultural anthropology. The Society has also a sepia portrait and an oil painting of Annandale in its rooms. In appealing for funds to perpetuate the memory of Annandale, the Council of the Society paid to him the following tribute:—

"Dr. Annandale occupied the foremost place in the ranks of Indian Zoologists. His scholarly research work earned for him meritorious recognition from the premier scientific Society in the world. His enthusiasm for the cause of scientific education in India was abiding. In him was combined the rare distinction of a

scholar, erudite and industrious, and a personality, modest but engaging."

It is also in the programme of the Society "that the balance of income of the Annandale Memorial Fund be suitably invested until the accumulated amount is sufficient, after paying for the triennial award, to provide Rs. 250 a year, to be utilised for a biennial Anthropological Lectureship.

Annandale was the last Superintendent of the Indian Museum and this office he held from 1907 to 1916. He succeeded Col. Alcock and relinquished the office on becoming the first Director of the Zoological Survey of India. The Trustees of the Indian Museum have also perpetuated his memory by putting up a brass tablet in the premises, the inscription on which reads as follows:—

"In memory of Thomas Nelson Annandale, C.I.E., M.A., D.Sc., Director, Zoological Survey of India. Superintendent and Secretary to the Trustees, Indian Museum. Born 1876, died 1924. Erected by the Trustees as a token of their esteem."

Lt.-Col. R. B. S. Sewell, C.I.E., F.R.S., Cidevant Director, Zoological Survey of India, at the request of the undersigned wrote a review of Annandale's work in India which is being published in the *Records of the Indian Museum*. It brings out very clearly how Annandale was far ahead of his times, for to him any taxonomic work involved correlation of the fauna "with the climate, the geographical position and geological formation, the vegetation and the composition of the water of each district surveyed." He was of the opinion that "No one formula can express, much less explain, evolution." He very often told the writer that it was his intention to write a book on "Evolution" during leave which he intended to take when death snatched him away from us. His later writings show the magnitude of the loss suffered by the scientific world through his early death, for he had intended to incorporate the whole of his investigations and wide experience in his contemplated publication on "Evolution."

S. L. HORA.

¹An Obituary Notice of Nelson Annandale by the late Dr. S. W. Kemp appeared in the *Records of the Indian Museum*, 1925, **27**, 1-28.

OBITUARY

PROFESSOR BIRBAL SAHNI, M.A., D.Sc., Sc.D., F.R.S.
1891-1949

THE cutting short of Birbal Sahni's life at a time when a new epoch of further fruitful activity appeared to be commencing for him came as a painful shock to every one. I had myself sent him a telegram, ten days prior to his death, expressing my confident hope that the newly established Institute of Palæobotany would, under his direction, make valuable contributions to science and to national welfare. At this juncture, when India's science is being reorganized under a new dispensation, Sahni could indeed ill be spared. It is appropriate that *Current Science* should publish appreciations of Sahni's life and career from several India's leading botanists. These naturally contain expressions of their profound sorrow at his being called away in the midst of his work.

I had known Sahni myself for thirty years, having first met him when I was a guest at his father's house in Lahore, delivering a course of lectures at the Punjab University. Since then, we had come together, travelled together and worked together many times and at many places. Every fresh contact only served to strengthen the impression produced on me of a most lovable personality, full of vigour and enthusiasm, and endowed with an unbounded passion as well as a very remarkable capacity for scientific achievement. Amongst the many pleasant memories which I carry in my mind is of my stay on more than one occasion at Lucknow as the guest of the Sahnis in the beautiful home which they built for themselves on the banks of the Goomti river. I cannot help feeling that it was in the highest degree appropriate that it was ultimately decided to locate the Palæobotanical Institute in the city with which the Sahnis were for so many years and so happily associated.

It is scarcely necessary for me to write anything more, except to add that I associate myself fully with all that has been said by his distinguished scientific colleagues in the following pages.

C. V. RAMAN.

IT is my task, honourable yet painful, to pen a few lines about the late Professor Birbal Sahni, Sc.D., F.R.S., both as a man and as seen against the background of science.

But in these few lines I do not propose to present anything like a critical estimate of Prof. Sahni's career, for the simple reason that I stood too near him to be able to possess that aloofness without which no such estimate can be usefully attempted. This very nearness, which disqualifies me to a certain extent, gave me exceptional opportunities to become acquainted with his innermost thoughts and hopes, with his ideals and aspirations, and with the main springs of that magnetic influence, which he exercised on all who came in contact with him.

Born on November 14, 1891 in the Punjab, he was the second son of the late Prof. Ruchi Ram Sahni of the Government College, Lahore. After a distinguished career at the Central Model School and at Government College, Lahore, he left for England in 1911 and joined Emmanuel College, Cambridge. After taking his degree in Natural Sciences tripos with high honours he took up research under the renowned palæobotanist Sir Albert Charles Seward. His inspiring guidance created that love for research in young Sahni which can be found only amongst great masters of a subject. While at Cambridge Sahni received grants from the Royal Society and from his own College in aid of his valuable researches. He remained in England throughout the first World War and in 1919, after his D.Sc. of the London University he returned to India to join the Benares Hindu University as Professor of Botany. In 1920 he left the Hindu University to take up his appointment as Professor of Botany at the Government College, Lahore. But within a year he left Lahore to take up his appointment as Professor of Botany at the newly started University of Lucknow, where he remained till his death. His sudden and untimely death only six days after the laying of the foundation-stone of the Institute of Palæobotany has deprived us of one of the world's greatest botanists.

The first thing that struck any one who came to know Prof. Sahni, was his pure, fervent and profound love for Science. In all my experience, I have met only one other, so utterly absorbed, day and night in thoughts of science and that is Sir C. V. Raman. To these two, India's past was and is a matter of great and legitimate pride,



PROFESSOR BIRBAL SAHNI, M.A., D.Sc., Sc.D., F.R.S.

1891—1949

but even more than the past they thought of the present and future and this was the root of their matchless and astonishing activities in their respective and varied fields of scientific activities.

We all know how faithfully Prof. Sahni lived upto the ideal he set before himself. His was a noble mission, but the cost he had to pay for it was by no means a light one. I do not speak of the sacrifice of physical comfort which it involved, but the mental suffering which he had so often to endure. The present transitional state of our education in general and Science in particular, brought in its wake the conflict between two forms of duties, viz., (a) the duties of the educationist and to scientist to the State and (b) the duties of a true devotee of Science wedded to research. He chose the latter path to which temperamentally he was also suited. For he lived and moved on a plane of his own far removed "from the madding crowd's ignoble strife".

Prof. Sahni's contributions to Botany, Palaeobotany and Geology are mainly of the nature of his own original researches. Many of his extensive memories have been published in the *Philosophical Transactions of the Royal Society* and in various other foreign and Indian Journals. Beginning with some papers on living plants he published extensive papers on the structure and affinities of certain Zygopterid ferns. His detailed work on the revision of the Indian Gondwana plants started with a joint paper published in 1920 in collaboration with his teacher Professor Sir A. C. Seward. In these he not only described a number of entirely new fossil plants but by the employment of improved technique of investigation at his laboratory he was able to revise completely the knowledge about several old species and their geological ranges. Along with these and closely following them came his numerous papers on the structure and affinities of the various Indian fossil plants from the Palaeozoic to the Quarternary beds. In his latest epoch-making paper published just before his death, he founded a new group of Gymnosperms—the Pentoxyleæ.

Besides the morphological and structural aspects of fossil plants he has dealt with the succession and geographical distribution of fossil floras against their climatic, physical and evolutionary background. In addition

Sahni's researches have materially helped to elucidate and solve such vexed geological and palaeobotanical problems as Wegener's theory of continental drift, the age of the Deccan Intertrappean beds now settled as Eocene, the age of the Punjab Saline series now largely recognised as Tertiary, the origin and character of the *Glossopteris* flora during the Palaeozoic ice age and the "Himalayan uplift since the advent of man".

Prof. Sahni had a wonderful faculty of infusing the spirit of research amongst his varied students. And to his students, scattered all over the country, he was like the central sun from whom they derived their light and warmth and round whom they moved each in his own orbit and at his own distance. The feeling of devotion that he was able to inspire was reminiscent of the relationship of *Guru* and *Shishya* found in the ancient culture of India. While we may proudly claim him as our countryman, the discoveries of Science have belonged and must necessarily belong, to the whole world; and Sahni's achievements in Science are a part of the common heritage of all peoples.

In token of his great contribution to science various scientific societies in India and elsewhere showered on him their highest honours. He was made a Fellow of the Royal Society in 1936, was the General President of the Indian Science Congress in 1940 and quite recently he was elected to preside over the forthcoming International Botanical Congress to be held at Stockholm.

His brilliant success in the scientific field was in no small measure due to his charming and devoted wife Shrimati Savitri Sahni. She had been his life-long guide, philosopher and friend. On many occasions she has helped him in the corrections of his numerous papers and later shared a fair proportion of his administrative work connected with the Institute of Palaeobotany. We share with her great loss and pray that God give her the necessary strength to carry through the unfinished task of Prof. Sahni.

I shall now close with a quotation by a great poet:

"Farewell, farewell, a nation's love
A nation's prayers watch o'er thee love,
Nor space nor time can part thee ever
From hearts that here adore thee".

SHRI RANJAN.

ON the 10th April 1949, the botanical world suffered an irreparable loss by the sudden and tragic death of Professor Birbal Sahni, the Director of the Institute of Palæobotany, Lucknow, and, until recently, the Professor of Botany and the Dean of the University of Lucknow. India has lost one of its greatest sons. It was just a week previously that we were so happy over the fact that the foundation-stone of the Palæobotany Institute at Lucknow was laid under such delightful auspices by the Prime Minister, Pandit Jawaharlal Nehru. And a few days after this great event, we were still further overjoyed to learn the very happy news of Professor Sahni's election to the Presidentship of the Seventh International Botanical Congress at Stockholm in 1950, the greatest honour that could be conferred on a botanist. The establishment of an institute for palæobotanical research in India had been one of Professor Sahni's most cherished desires. He endowed practically all his property for the starting of this great institution. His idea in establishing this institution was that, apart from its work of carrying on research in palæobotany, it should have a wide international outlook and that it should strive to promote cultural contacts with other countries through an exchange of students and by inviting foreign scholars as Visiting Professors. It was most befitting that a great international personality like Pandit Jawaharlal Nehru should have honoured this international institute of Professor Sahni by laying its foundation-stone. It is a tragic irony of fate that, so soon after these two happy events, Professor Sahni should be snatched away so suddenly like this. He was cut off in the fulness of his powers. His contributions to palæobotany are rich and full. But he had still such a lot to do for his science and for his Palæobotany Institute.

He was born on the 14th November 1891 at Bhera, Shapur District, West Punjab, and was the second son of Professor Ruchi Ram Sahni, M.A., Emeritus Professor of Chemistry, Government College, Lahore, and Shrimati Ishwar Devi Anand. He married in 1920 Savitri Suri, younger daughter of the late Shri Sundar Das Suri, M.A., Inspector of Schools, Punjab.

He was educated at the Central Model School, Lahore, Government College, Lahore, and at Emmanuel College, Cambridge (where

he was a Foundation Scholar and Exhibitioner and secured the Hardyman Research Prize). He also attended the Summer Semester at the Munich University.

He was one of the founders of the Indian Botanical Society which was started in 1921 and was its President in 1923. He was Vice-President of the Indian Association for the Cultivation of Science for some time, President of the National Academy of Sciences of India for two years in 1937-38, Government Delegate to the Imperial Botanical Conference in London in 1935, Delegate to the Tercentenary of *Muséum d' Histoire Naturelle*, Paris, 1935, Fellow and Vice-President of the Indian Academy of Sciences, Fellow and Vice-President for some time of the National Institute of Sciences of India, President, Lahore Philosophical Society, Fellow of the Royal Asiatic Society of Bengal, Non-Official Member, Indian Delegation to Royal Society Scientific Conference in 1946.

He was elected a Fellow of the Royal Society in 1936, being the fifth Indian to be elected for this honour. He was a Fellow of the Geological Society and a Foreign Honorary Member of the American Academy of Arts and Sciences.

He was the President of the Botany Section of the Indian Science Congress in 1921, President of the Geology Section of the Indian Science Congress in 1926, and President of the Botany Section of the Indian Science Congress Jubilee Session in 1938. And he was General President of the Indian Science Congress Meeting at Madras in 1940.

He was a Vice-President of the Palæobotanical Section of the Fifth International Botanical Congress at Cambridge in 1930, and a Vice-President of the Palæobotanical Section of the Sixth International Botanical Congress at Amsterdam in 1935. And, just before his death, he was elected the Honorary General President of the Seventh International Botanical Congress at Stockholm in 1950.

He was awarded the Barclay Medal of the Royal Asiatic Society of Bengal in 1936 for outstanding researches in Biological Sciences, the Sir Cattamanchi Ramalinga Reddy National Prize for National Technology in Sciences, Agriculture and Technology in 1947, and the Nelson-Wright Medal of the Numismatic Society in 1944.

He was Professor of Botany, the Benares Hindu University, during 1919-20, and was,

later on, Honorary Professor of Botany at the same University. He was Professor of Botany, University of Punjab, during 1920-21, and Professor of Botany, University of Lucknow during 1921-46, and Dean of the Faculty of Science of the Lucknow University during 1933-46. He became the Founder-Director of the Institute of Palæobotany in 1946.

He had a most charming manner, and a frank and engaging countenance. And, with his ready smile and his large and bright and thoughtful eyes, he had almost a boyish appearance. In fact, in heart and mind, he actually did remain young and energetic throughout his life. He was always simple, sincere, modest and unassuming and was most gentle and kind to every body. He was greatly loved and respected by the younger generation of research workers, on account of his geniality and his readiness to give them all possible help whenever necessary. And he commanded the affection and high regard not only of a large number of scientists but also of persons in other walks of life. In foreign countries, he was held in very high esteem, and numerous eminent foreign scientists were attached to him as personal friends.

By nature, he was ardent, enthusiastic and energetic in anything that he undertook. His industry was amazing. And his own industry and zeal was always infectious and could be seen reflected in every one of his research students and colleagues. It was this unique quality of his which enabled him to gather round himself a large body of enthusiastic research workers and which helped him to establish finally a great school of research in Palæobotany at Lucknow.

He did much to further botanical research in India, not only in his own special branch, viz., palæobotany, but in all the other branches of the subject as well. He had a burning desire to raise the standard of botanical research to the high level that is seen in foreign countries, if possible, even to a higher level. Surely he had succeeded to a very large extent in this attempt. He was a great nationalist in his outlook, but I must however, point out that his nationalism was not so bigoted as to prevent him from being a great internationalist as well.

He was an excellent speaker and had a very agreeable voice. His lectures and public addresses were always a delight to hear. Both in his speeches and in his publications,

he always expressed himself most clearly and faultlessly. Crystal clarity of thought and careful planning characterised all his publications.

After having had an excellent training in research work in palæobotany under the late Professor Sir Albert Steward at Cambridge, he returned to India in 1919. When he came to India, he found that the study of Indian fossil plants was occupying only a very subordinate position in Indian Botany. Though a good deal of knowledge of fossil plants had accumulated, all this knowledge was due to the work of the geologists, who were interested in the study of plant fossil merely as indices of the geological strata. None of the Indian botanists had taken up the study of the fossil plants of the country, and not much was known regarding the structure and affinities of most of these fossil plants. So he immediately started an intense and sustained research work on the Indian fossil plants. He also trained up a large number of students and members of his teaching staff in research work in palæobotany.

During the years 1919 to 1949, he and his colleagues published a host of most valuable papers on palæobotany. Among the many outstanding palæobotanical problems that were tackled by him may be mentioned: The Gondwana flora, the Deccan Intertrappean flora; the age of the Deccan Traps; the age of the Saline Series; Micropalæontological work for correlating the oil-bearing rocks of Assam for the Burma Oil Company; Wegener Theory of Continental Drift; the age of the Glossopteris flora; and the land connection between Gondwana Land and Angara Land. Among the other publications may be mentioned several papers on the Jurassic flora of the Rajmahal Series, the fossil flora of the Karewa beds in Kashmir and the light they throw on the Himalayan uplift and the climatic changes in the Kashmir area, *Pentoxyleæ*, a new group of Jurassic Gymnosperms showing a combination of features characteristic of the Cycadales, Coniferales, and Bennettitales, *Homoxylon* and its systematic position, etc., etc.

He summarised the position of palæobotanical knowledge in India periodically in his masterly addresses before the meetings of the Indian Science Congress, the Indian Academy of Sciences, and the National Academy of Sciences. He also organised several symposia under

the auspices of these learned bodies on various important palaeobotanical problems many of which had important bearings on geological problems, especially the ages of certain series. Professor Sahni was very largely responsible for bringing the botanists and geologists together. In 1926, in his Presidential Address before the Geology Section of the Indian Science Congress Meeting at Bombay, he said that fossil plants represented a debt that botany owes to geology. In the conclusion of his presidential address before the Botany Section of the Indian Science Congress Jubilee Session in 1938 at Calcutta, he said that the botanist had by his study of the fossil plants been able to repay at least a part of the debt he owed to the geologist. He had helped the geologists through a study of the fossil flora to decide the age of several strata.

Professor Sahni has also published some valuable contributions to Archæology and Numismatics.

During his last days, he was busy working on the Devonian flora of Spiti and the silicified flora of the Rajmahal Hills.

It is not easy to assess the full extent of the loss that the botanical world has sustained through the sudden passing away of this great man. The void left by him cannot be filled for a long time to come. Only posterity will be able to form a real estimate of his great contributions to Botany. He has left behind him a great tradition, a great example and a wealth of knowledge, which will be a constant source of inspiration to all botanists and will keep his memory green and alive wherever palaeobotany is studied.

M. O. P. IYENGAR.

HAVING had the privilege of being associated with the late Professor B. Sahni for nearly twenty-two years, first as a student, then as a collaborator and colleague, I value very highly indeed the kind invitation extended to me by "*Current Science*" to offer my humble homage to the memory of my illustrious guru.

I shall endeavour to give in this brief note my impressions of India's greatest botanist as a teacher and as a leader of botanical research, two aspects with which I have been familiar more than anybody else.

Professor Sahni was not only a gifted teacher but also an ornament to the profession. His profound knowledge of the subject

and his natural style were unrivalled. He was inimitable. It was a treat to listen to his lectures. They were characterised by remarkable clarity, directness of expression, a simple and lucid style and a wide sweep of facts. He was very exact in his expression and meticulous in his language. Professor Sahni had the knack of making the most difficult problems exceedingly clear, particularly to the graduate classes, first stressing the most important facts in the order of their importance and then drawing in details. The students loved this direct and simple style, which they could follow without any effort, and gathered full strength to attend his lectures.

His lectures to the post-graduate classes were bound to be heavy with a wealth of facts and details. There was no time limit to it; there was no waste of time or words either, but facts poured in quick succession and perfect sequence all in a convincing fashion. Difficult problems were made exceedingly clear and new theories were explained in a masterly way. All sides of a controversy were placed equally clearly without prejudice to any and there was no compulsion to favour any view, except to be guided by facts and facts only. One was always struck by his remarkable mastery of the subject and its wonderful exposition. With the above gifts Professor Sahni combined a wonderful skill in sketching. With miraculous speed he would sketch on the blackboard the necessary figures without leaving a single detail and facts and figures would always keep pace with each other in his lectures.

It was a regular habit with him to enter in his notes all references to the latest work as soon as it appeared in print. So his lectures were always up to date and even unpublished work or work in progress in the department would be referred to. Complete references to original papers were invariably given whether they were in his notes or not for he had a wonderful memory and his references to published literature were accurate almost to the page. Even during these lectures the idea of research would always be in the background. After finishing each group in his lectures, he would invariably draw attention to various research problems in that group—particularly in India. For the post-graduate student whose aim was research or even for the student who had just embarked on a re-

search career, his M.Sc. lectures were not only enormously informative but also exceedingly suggestive. Many of the outside workers, even teachers from outside who used to join the department for the Ph.D. or D.Sc. classes, would invariably attend his M.Sc. lectures and profited by it immensely. Professor Sahni could handle any subject with ease and mastery. He was as much at home in lecturing on Fungi or Genetics or Systematic Botany as he was in lecturing on the Morphology of Angiosperms of Pteridophytes or Gymnosperms. In fact he has taught all these subjects some time or other to the degree and post-graduate classes although latterly under pressure of work he had confined himself to the last two groups of botany in which he was naturally in his best elements. Particularly his treatment of the group Gymnosperms of which he was a master was simply marvellous. Whether it was his class-room lectures or lectures to a lay audience, he held the audience spell bound by his eloquence, correct pronunciation, right accents and a free and natural diction.

In the practical classes too Professor Sahni never rested for a minute. He was always explaining something or correcting some books or discussing some problem and would invariably come round to research and give a few useful tips. This would go on sometimes even beyond the scheduled hours often late into the evening but none grumbled for one used to learn such lot during these informal talks. Himself a very hardworking person he expected others also to work hard and nothing pleased him so much as a hardworking and conscientious student. One of his favourite sayings was "*Hard work killed no body*". He insisted upon neat, orderly and methodical work, accurate sketching and correct labelling and attention to details. The clumsy and careless worker would always invite a severe but nonetheless courteous rebuke often sarcastic, which was very effective indeed. In the class-room Professor Sahni was a perfect disciplinarian but induced it by his own exemplary behaviour, and unflinching courtesy than by any harsh words. Even the most turbulent class would become absolutely quiet immediately he entered the room.

Another sign of greatness in him which I have seen in the class-rooms was his admitting frankly his ignorance of certain things. To some kinds of unanswerable questions he would offer no teleological explanations but

would mystify his young audience by the simple statement 'I do not know'. He would follow this by suggesting books where the point might be looked into further and would ask the students to come to him if they had any difficulties.

As a director of research Professor Sahni was unrivalled. He inspired the love of research in every one who came in contact with him. He could make a good research scholar of any kind of student. He had the gift to draw out the best in every student by sympathetic interest and timely encouragement. He would offer a wide choice of problems to the new research scholar and after the selection was made would sit with him regularly and give detailed instructions and references. Research was the passion of his life and he expected every scholar to share it. He admired conscientious and hard work even if it did not yield quick or spectacular results. He insisted always upon a very high standard of research—stressing more on quality than on quantity. He was critical, sometimes hypercritical in examining the student's work; his results were subject to the most rigorous scrutiny, all in the interest of the student himself. Once the results and the research paper were approved by Professor Sahni the student was supremely satisfied. He knew that his work was fully purified. Professor Sahni insisted on the research paper being fully illustrated and flawless in every detail. The language had to be very exact and opinions guarded. Superficiality, hasty conclusions and irrelevant facts always irritated him. He hated the ponderous style and involved constructions. He always used to say "Know what you have to say and say it straight". He insisted on brevity, directness and clarity. 'Never use two words when one can serve the same purpose' was his maxim. When facts were not sufficiently convincingly put he would say curtly with a smile 'I am not convinced'. 'Put yourself in the place of the reader who does not know the subject and see if you are convinced' he would add, correcting the manuscript. He had an eagle eye for details in research as well as in publication. Not a single spelling mistake, typographical error or printer's devil would escape his eye. Professor Sahni's guidance in research was not only inspiring but also bred confidence and caution in the young worker—two qualities most essential for a successful research career. It was a pleasure to collaborate

with Professor Sahni in any research. The junior worker was treated as an equal, his opinion invited and more credit given to him than was his due.

Himself a great collector of plants—living and fossil—he insisted on his research scholars collecting their own material with complete field notes. His own tour notes and collection data are a mine of information, however hastily they may have been drawn.

Often have I seen him in the museum or class-room examining hurriedly specimens still to be worked out and wistfully exclaim "A life-time is too short for working out even a few of these silicified blocks". And yet how much he accomplished in his own brief life-time!

I cannot conclude this note without referring to the human side of this great scientist and teacher. His unflinching courtesy, personal charm, cheerfulness, refined manners and radiant smile, all contributed to his magnificent personality. He had a very fine sense of humour and would enjoy a joke even at his own expense. He mixed freely with students and it was mostly at informal gatherings or excursions that one could see the remarkably human side of him which was covered by a busy and restless exterior. He was a thorough sportsman and was a keen tennis player and chess enthusiast. A nationalist to the core he had always an international outlook in scientific and humanitarian fields.

Indian science has sustained an immense loss in the passing away of Professor Sahni. To the Department of Botany in this University which he organised and raised to the foremost centre of botanical research, it has been an irreparable loss. To me who had been associated intimately with him for more than two decades and had been influenced by his personality to a measure which cannot be expressed in words, Professor Sahni's demise has been a personal shock indeed. This has been so to numerous students of his who looked upon him as their greatest friend and beloved guide. Although his beaming face smiles at us no more in flesh and the inspiring voice is hushed for ever, yet to those of us who had come under its magic spell they will live for ever and ever in our memories. May his soul rest in peace!

A. R. RAO.

STUDENTS and colleagues of Professor B. Sahni, Sc.D., D.Sc., F.R.S., all over India were deeply grieved at the sudden and abrupt end of a great and distinguished career. To every student of his the loss is irreparable for, there has been such a great personal spell cast on us by this remarkable personality that we keep on repeating in our minds "Our beloved Professor is not gone, he is always with us". Such was the regard we had for Professor Sahni!

In 1934, I nervously entered the Botany Laboratory at Lucknow and met my Professor for the first time. I had sent in my card and was called in immediately. Professor Sahni got up from his chair and with his inimitable smile gave me a warm firm handshake. I was charmed by the personality, charmed beyond words. Those soft yet crisply spoken words of welcome still ring in my ears not dimmed in audibility by the passing of years and that momentous meeting started an affectionate relationship between teacher and taught and has continued ever since only to be prematurely broken by the passing away of my illustrious teacher.

Professor Sahni was a lucid speaker. His lectures were a delight; erudite, masterly and thorough, in short, *par excellence*. Who can forget his thoughtful introduction to the Pteridophyta, his genial and often humorous comments on the various views expressed by contemporary thought on the engrossing topics relating to evolutionary tendencies in the group? Who dare forget his masterly sketches, so swiftly and dexterously made with both hands! His excellent discourses on the Bennettitales, the Caytoniales, the fossil and living gymnosperms, the theories connected with the stellar evolution; the remarkable facility with which he would refer to the most intricate problems connected with the phyllode theory or any other, all remain a great treasure to those who have had the good fortune to have learned Botany from Professor Sahni.

Professor Sahni's greatest gift, perhaps, was his ability to put a student at ease. Ignorance of the individual in the matter of correct knowledge in the subject was to him no matter for ridicule. On the contrary, he would enlighten the young seeker with all the seriousness of a genuine teacher. I am reminded of an incident when I was doing my Master's Degree. On apologetically requesting the Professor to explain a particular structure in the sporocarp of *Marsilia* quick came

the answer, "a postmaster needs no request to affix the date stamp, so too the duty of a Professor, it is his privilege to teach!" Years later when I had the privilege of being on Professor Sahni's staff, short though the period was, I was called upon to deliver a talk on some of my researches. The post-lecture discussion was initiated by Professor Sahni in these words, "I shall be glad if all of you will heckle the lecturer; there is a misnomer amongst us that new ideas of a research worker should not be shared for common good. I may say this, the more ideas you give or take out of a research worker the more he will get. The most successful research worker never hesitates to discuss his new ideas with his colleagues". Such was his liberality on academic problems.

There were a number of outstanding characteristics of the Professor which are worthy of emulation. Foremost among these was his great humility. In the class-room he would seldom speak at length of the scientific contributions of himself, his students or colleagues. Another quality was his desire to give equal impetus for other workers to develop their fields of study. He would often state that the finances of his department had to be uniformly spent on all branches of Botanical teaching and research. It could be said without any fear of contradiction that the establishment of research schools in Plant Pathology, Physiology, Bryology and Ecology in his department, hand in hand with his special branch of Palaeobotany, shows the tolerance and sagacity of the Professor. In many of his lectures he would refer to the importance of the various branches and stress the need for an all-round knowledge in all branches of botanical teaching and research.

There are many incidents that made a great impression on the Professor's students. In one of the lectures Professor Sahni was late by five minutes. As soon as he entered the lecture theatre, smart came an apology "in my long career as a teacher I have not been late by five minutes, I owe you my apology". That was characteristic of him! In the practical classes the Professor would give

detailed instructions to every student and in spite of his multifarious duties, he would make it a point to attend to his work with the graduate students, the post-graduates and the research students, indeed, every little detail would be gone into. When closeted with research students he would stress the need for precision, neatness and promptness. Mentioning about promptness, I should like to record here that personal correspondence with the Professor was always a great pleasure for anyone, as they could depend on him for a prompt, courteous reply. I remember his mentioning to me that normally no letter was kept pending for more than twenty-four hours! Professor Sahni's interest in students went beyond his Department of Botany. As Dean of the Faculty of Science he had fixed hours of interview, when the under-graduates and post-graduates had an equally uniform reception. Indeed, many belonging to the other science departments were known to him by name—a tribute to his power of remembering faces and names.

There have been occasions when I travelled in this country with Professor Sahni. They were rare privileges when one would be faced with his profound humour, deep understanding of human problems and great simplicity. But more than these grand human qualities, he had a love and affection for his students which was unfathomable. In one of my train travels with Professor Sahni I was overwhelmed to see the Professor making towards my compartment at midnight to bid good-bye in the typically Sahnian fashion since he had to change on to another route. One could narrate so many incidents that have made a deep and everlasting impression on our minds. To us Professor Sahni's passing away is an irreparable loss, but to India, his geniality, sense and love of duty, devotion to the welfare of his pupils stand as soft focussed spotlights which I hope and trust may fall kindly on many a young rising teacher who might mould his character on that of the Doyen of Indian Science, our revered and respected Professor Birbal Sahni.

T. S. SADASIVAN.

LETTERS TO THE EDITOR

	PAGE		PAGE
<i>Prohibition and Health</i> —M. C. NAMBU DIRI-PAD	166	<i>Note on the Occurrence of the Weevil Diocalandra stigmaticollis Gyll., as a Pest of the Coconut Palm in Travancore</i> —K. V. JOSEPH	173
<i>On the Spectrum of Flame Containing Potassium Salts</i> —S. P. SINHA	168	<i>Telia of the Leaf-Rust on Teak</i> —M. J. THIRUMALACHAR	175
<i>New Bands of Columbium Oxide</i> —V. RAMAKRISHNA RAO	168	<i>The Optimum pH of Clostridium lacto-acetophylum</i> —J. V. BHAT	177
<i>Gypsification of Apatites in the Kodurites</i> —C. MAHADEVAN AND G. PRABHAKARA RAO	169	<i>Tubers in a Species of Anthoceros</i> —K. SUBRAMANYAM AND B. A. RAZI	178
<i>Vanadimetry—Part III</i> —M. NARASIMHASASTRI, J. V. S. RAMANJANEYULU AND G. GOPALA RAO	169	<i>Two Ectoparasites of the Bat Rousettus leschenaulti Desm.</i> —D. V. BAL AND F. AHMED	179
<i>Thorium Periodate and its Use in Thorium Estimations</i> —M. VENKATARAMANIAH AND BH. S. V. RAGHAVA RAO	170	<i>A New Plough for Indian Cultivators</i> —D. T. BROWN	180
<i>A New Synchytrium on Phaseolus mungo</i> —M. K. PATEL, Y. S. KULKARNI AND G. W. DHANDE	171	<i>Cerebella on Sugarcane</i> —H. C. GOVINDU	180
<i>A Case of Simultaneous Mutation of Two Independent Genes in the Chilli Capsicum annum L.</i> —R. B. DESHPANDE	171	<i>Note on a "Schorlite-Penninite" Rock from Shimoga District, Mysore State</i> —C. GUNDU RAO	181
<i>Index for Earliness in Sugarcane</i> —S. V. PARTHASARATHY	172		

PROHIBITION AND HEALTH

THE September (1948) issue of *Current Science* contains a masterly leading article on the "Scientific and Economic Aspects of Prohibition". But, I am afraid, some important health problems arising from Prohibition have been overlooked in the article. True, 'drink devil' has become a problem and a menace in regard to the health of the community. But, strangely enough, prohibition too will bring in its train a number of important health and nutritional problems, which the scientist and the administrator will do well to study.

In his book, "The Inequality of Man" Prof. J. B. S. Haldane, F.R.S., draws attention to the 'Tragedy of Nauru,' an account of which appeared in the *Proceedings of the Royal Society of Medicine* (1930).

"Nauru or Pleasant Island lies in the Pacific Ocean near the equator and contains large deposits of phosphate. So its inhabitants contribute to the world over-production of food (Haldane refers only

to the food situation in 1930) by exporting portions of their native land. They were in the habit of drinking toddy made from fermented palm-juice and on occasions became very tipsy in consequence, which doubtless lessened their efficiency as excavators. Nauru is governed by Australia under a mandate from the League, and the paternal Government issued an ordinance forbidding the use of toddy. Perhaps the efficiency of the natives as labourers increased, but their infantile mortality rose to 50% within six months of this law coming into force.

"It was found that the children at the breast were dying of beri-beri, a disease due to the deficiency of Vitamin B₁. This substance is nearly absent from the rather monotonous diet of the mothers, but is present in large quantities in the yeast from which the toddy is made. The Medical Officer of Health discovered this fact and (doubtless after an appropriate delay) toddy was allowed again. The infant mortality immediately fell to 7%.

"The situation in many areas of Central India is quite similar. Large sections of the population are on the borderline of Vitamin B₁ deficiency, and suffer from time to time from mild beri-beri. In these circumstances, adults generally survive in rather poor health, but breast-fed children die. This dietary deficiency is at least to some extent supplemented by the use of toddy made from palm-juice" (Haldane).

For the past several years, we have been experiencing the rigours of an unprecedented food-shortage. That means, we have been systematically semi-starved all these years. Our general health condition has, as a result, deteriorated, with the consequential diminution in our resistance to disease. The low rate of ration obtainable often happens to be very poor in quality. If our food was deficient in Vitamin B₁, even in the days when good-quality food was not scarce, surely there is reason to think that our present-day diet would be completely devoid of any trace of vitamins and other ingredients of special food-value. At best, we would be consuming only foods of 'fuel-value' such as those rich in carbohydrates—vitamins, proteins and minerals never coming into the picture!

Prohibition should be viewed against this background. Prohibition of distilled drinks, such as arrack and imported varieties, is quite welcome. Those drinks have no food-value and they do irreparable harm. But, prohibition of crude toddy takes away from the hands of the ordinary labourer, his only source of vitamin supply. The well-to-do members of the community invariably go in for 'costly drinks', which means distilled ones. Even if some of them have been using crude toddy, before the introduction of prohibition, they can now afford to turn to costlier ways of fighting Vitamin deficiency. To the common labourer, no such alternative exists.

It is therefore the duty of the Government to look into this matter at once. Along with the provision of recreational facilities to the drink-deprived, an organised effort should be made to distribute vitamin tablets free of cost, among the poorer sections of the population; a propaganda party should tour villages and towns to instruct the people as to the necessity of taking in the required quantity of vitamins. This should be followed up by extensive

research to devise ways and means to "vitaminise" the common man's food. We hate taking pills daily for a life-time. Our ordinary diet should therefore be made to contain vitamins in sufficient quantity. Not only that, some cheap method, having a good popular appeal, should be developed to supplement our food with vitamins. For example, raw polished rice could be banned and unpolished parboiled rice compulsorily introduced instead. In the process of polishing, the outer layers of rice are removed. It is at present used as animal food, while it can be profitably used for human consumption in the form of bread and cakes. In Japan, it is used in pickling. The same method can be advantageously adopted in India, as pickles occupy a pride of place in Indian food. More use of vegetables, fruits, pulses, etc., may also be popularised. These are some only suggestions as to the courses research should take.

Another question, though not scientific, inevitably props up, when discussing prohibition. Is it worth-while to embark on prohibition at this juncture, at the cost of great nation-building schemes? To take but one example from Madras: Madras loses about 17 crores of rupees annually consequent on the introduction of prohibition. The Government have before them a good number of schemes to increase by millions our acreage of food-crops, by the construction of dams, etc. Some of these plans are either delayed or postponed indefinitely for want of funds. If therefore prohibition could be postponed by a couple or more years, we would be able to divert at least this seventeen crores to finance those schemes. When once our food position is secure, we can safely and with confidence, embark on our long-cherished ideal of total prohibition. Another thing: by postponing the introduction of prohibition by only one year, Madras will be able to give immediate effect to the abolition of the Zamindari system, as the compensation payable can be met from current earnings alone! These may seem a bit too harshly realistic; but we cannot escape these realities by simply shutting our eyes.

Trichur,
Cochin State, M. C. NAMBUDIRIPAD,
January 21, 1949.

ON THE SPECTRUM OF FLAME CONTAINING POTASSIUM SALTS

PANAY¹ has reported a continuous spectrum of potassium obtained by introducing into a Mecker burner air carrying atomised KCl solution. He has examined the intensity distribution in this spectrum between λ 5600 and λ 4110 and found a maximum at λ 4430 and a minimum at λ 5400. The continuous spectrum extends farther into the ultra-violet with gradually diminishing intensity and in the visible region, superposed over the continuum are a few lines of potassium, viz., λ 7699-65, λ 4047-44 lines of the principal series, λ 6939-11, λ 5340-23 lines of the sharp series and λ 5360 line of the diffuse series, the D lines of sodium and two feeble lines at λ 4947 and 4637. A band at λ 5650 and another between λ 6180 and λ 6460 spreading possibly to λ 6050 and λ 6730 have also been noted by him.

To understand clearly how the continuum and the different bands and lines noted by Panay arise, the spectrum of flame containing atomised KCl has been photographed in essentially the same manner as by Panay and a continuous spectrum extending from the long wavelength limit of an Ilford panchromatic plate down to about λ 3000 Å (fainter continuum extends to even shorter wavelength) has been obtained. The continuous spectrum in the visible region shows a maximum and a minimum near the regions described by Panay and has superposed over it the D lines, the C_2 bands at λ 5636, λ 5165, λ 4737, λ 4382, and the strong members of the OH bands at λ 3064. The red K lines could be seen visually but were beyond the sensitive region of the plate. The second members of the principal series of potassium appeared but no sharp series or diffuse series lines mentioned by Panay were obtained.

To eliminate the effect of the gas flame, its spectrum uncontaminated by any salt, was photographed. This showed essentially the same features as above (including even the D lines). The inner cone of the flame gave the bands much stronger over the continuum than the outer cone. Further, the continuum was stronger in the flame containing KCl than in the one without it. The spectrum was also photographed with atomised NaCl in the flame. This again showed the same features as the KCl flame; the D lines were stronger.

It thus seems that the continuum refer-

red to by Panay has nothing to do with potassium in particular. It rather belongs to the type of continuum which is ordinarily present in the flame and which has been attributed mainly to continuous electron radiation, i.e., radiation of the electrons in the field of ions formed in the discharge, by Finkelburg.^{2,3} The introduction of easily ionizable atoms like those of Li, Na, or K makes the continuum considerably stronger. Part of the spectrum might also be due to bimolecular association of the type of $NO + O \rightleftharpoons NO_2$ + yellow green continuum of the flame (see Gaydon⁴). Further, it is also difficult to see how some of the lines can be attributed to the sharp and diffuse series of potassium, as has been done by Panay, when intervening members of the series like the λ 5802 line of sharp series and λ 5832 of the diffuse series are absent. By assuming that the wave-lengths given by Panay are only approximate it is possible to explain some of the radiations as due to C_2 or CH, but it does not appear feasible to explain all of them in any satisfactory manner. In the present case, however, although a continuum similar to Panay's has been observed, no extra radiation which cannot be explained has been found to appear on the plate.

Science College,

S. P. SINHA.

Patna,

March 2, 1949.

1. Panay, T. N., *Compt. Rend. Acad. Sci. Paris*, 1937, **204**, 251.
2. Finkelburg, W., *Phys. Rev.*, 1934, **45**, 341.
3. —, *Ibid.*, 1934, **46**, 330.
4. Gaydon, A. G., *Proc. Roy. Soc., A*, 1944, **111**, 183.

NEW BANDS OF COLUMBIUM OXIDE

AN extensive band spectrum consisting of red-degraded bands and attributable to the CbO molecule has been observed in the region 6500-4200 Å.U., in the ordinary Columbiu arc in air and in heavy current discharge through $CbCl_5$ vapour. They could be distinguished as two systems: (1) from λ 6500-5600 and (2) from λ 5600-4200. The first system presents a complex vibrational structure. The second is more open and well defined with band-heads accompanied by partially resolved rotational structure. The prominent heads occur in widely separated regions at ν 19120, 20340, 21320, 22163, 22878, the separations between successive heads being 1220, 980, 843 & 715

cm.⁻¹ The intensity distribution in these heads suggests the probability of ν 20340 as the (0, 0) head. The two systems may be designated as γ and α respectively, on the analogy of the ZrO¹ and the TiO² bands which the present bands resemble closely.

Analysis of the bands is in progress and details will be published shortly.

V. RAMAKRISHNA RAO.

Physics Department,
Andhra University,
Waltair,

March 22, 1949.

1. F. Lowater, *Proc. Phys. Soc.*, 1932, **44**, 51.
2. *Ibid.*, 1928, **41**, 557.

GYPSIFICATION OF APATITES IN THE KODURITES

DURING the course of detailed chemical and optical studies of the Kodurites from the manganese mines of the Garividi area in the Vizagapatam district, a rather unusual case of the alteration of apatite to gypsum along the peripheral zones was noticed. The apatite is a manganese fluor variety with the formula $3(\text{Ca.Mn})_3 \cdot \text{P}_2\text{O}_8 \cdot \text{Ca} (\text{F}_2 \cdot \text{Cl}_2)$. During the optical examination, it was noted that the periphery of the apatite showed different optical features from those normal to the apatite. The central grain shows uniaxial negative characters with straight extinction, whereas the peripheral zone is biaxial negative with inclined extinction which polarizes with second order blues and pinks, characteristic of gypsum. The analysis of the apatite and its modal composition indicated 92.93% of apatite and 7.07% of gypsum.

Chertification and kaolinisation are universal in the Kodurites. The problem of the origin of the cherts and kaolin in this area as elsewhere is a debatable point, i.e., whether it is due to hydrothermal or meteoric alteration.

Vogt¹ in common with several other investigators attributed kaolinisation of the feldspars to carbonated waters. Lindgren² controverted this view on the ground that the pure aluminic silicate cannot be formed in the presence of carbonated waters alone and that the presence of H₂SO₄ is essential to bring about kaolinisation. Fermor³ ruled out this possibility on the ground that there was no evidence of the presence of the influence and action of H₂SO₄ in the Kodurites. The gypsification of the apatites in the

Kodurites of the Garividi area is fairly frequent and this points clearly to the action of sulphuretted waters. Therefore, it appears that the view put forward by Lindgren regarding the importance of H₂SO₄ in kaolinisation of feldspars really finds a support here since there is a replacement of apatite by gypsum (CaSO₄·2H₂O). The authors do not, however, claim that this alteration is brought about exclusively by hydrothermal agencies.

We are not aware of any reported occurrence of the gypsification of apatites in literature.

A detailed paper embodying the results of chemical and optical study of the Kodurites and associated formations by one of us (G.P.R.) is under publication elsewhere.

Geology Dept., C. MAHADEVAN.
Andhra University, G. PRABHAKARA RAO.
March 16, 1949.

1. Vogt, *Trans. Amer. Inst. Mining Eng.*, **31**, 150.
2. Lindgren, Waldemer, *Ibid.*, **30**, 658.
3. Fermor, L.L., "Manganese-Ore Deposits of India," *Mem. G. S. I.*, **37**, 274-75.

VANADAMETRY—PART III

Volumetric Estimation of Ferrous Salt in the Presence of Phenols

IN Parts I and II of this series the advantages of sodium vanadate as a volumetric reagent in place of permanganate or dichromate have been emphasized. Viswanadham and Gopala Rao³ have shown that citric acid in ferrisubchloridum citratum B.P. interferes in the estimation of ferrous iron, by potassium dichromate. They have proposed the use of sodium vanadate. Lyons and Appleyard¹ who found a similar interference by citric acid and sugars proposed ceric sulphate for the estimation. Ferrey⁵ showed that ceric sulphate does not give satisfactory results in the estimation of ferrous iron in the presence of phenol. As several phenolic compounds are used in pharmaceutical preparations as preservatives, it was considered necessary to investigate the problem in detail.

We have now found that dichromate oxidizes phenol, ortho-cresol, paracresol, m-cresol, and resorcinol, in the presence of ferrous salts by an induced mechanism. Ceric sulphate is capable of oxidizing the phenolic compounds even in the absence of ferrous salts to dirty coloured compounds

insoluble in dilute sulphuric acid, so that this reagent is not suitable for the estimation of ferrous salts in the presence of phenolic compounds. Sodium vanadate has, however, been found to give excellent results as shown in the following table.

Composition of solution		Amount of ferrous iron found by ceric sulphate titration	Amount of ferrous iron found by sodium vanadate titration
Amount of ferrous iron taken	Amount of phenolic compound		
millimols.		millimols.	millimols.
0.7191	nil	0.7200	0.7201
0.7191	0.5008 phenol	0.8230	0.7201
0.7191	0.5090 paracresol	0.8245	0.7201
0.7101	0.4684 ortho cresol	0.8212	0.7086
0.7101	0.4666 meta cresol	0.8194	0.7086
0.7139	0.4562 resorcinol	0.8945	0.7139

Sodium vanadate will thus be found to have some advantages even over ceric sulphate. Detailed results will be published elsewhere.

M. NARASIMHASASTRI.

J. V. S. RAMANJANEYULU.

G. GOPALA RAO.

Andhra University,
Waltair,
April 20, 1949.

1. Gopala Rao and Ramanjaneyulu, *Curr. Sci.*, 1949, **18**, 72. 2. Gopala Rao and Brahmaji Rao, *Ibid.*, 1949, **18**, 3. Viswanadham and Gopala Rao, *Ibid.*, 1943, **12**, 327. 4. Lyons and Appleyard, *Quart. J. Pharm. Pharmacol.*, 1937, **10**, 348. 5. Ferrey, *Ibid.*, 1937, **10**, 351.

THORIUM PERIODATE AND ITS USE IN THORIUM ESTIMATIONS

RAY CHAUDHURY¹ reports that thorium nitrate in dilute nitric acid solution yields on prolonged heating over a water-bath with excess of sodium paraperiodate a gelatinous precipitate of the composition $\text{ThHIO}_6 \cdot 5\text{H}_2\text{O}$. This substance is further reported to be stable upto 600°C. The strength of the acid solution has not been specifically mentioned, but our experiments with 2N acid using potassium periodate in place of the sodium salt have not been successful. We have therefore undertaken a more systematic investigation and our experiments show that precipitation occurs only at 1N or lower acid concentration. Even under these conditions significant quantities of thorium remain in solution though a ten-

fold excess of periodate is used. If, however, hot neutral potassium periodate is added in slight excess to a hot neutral solution of thorium nitrate, there results immediately a white gelatinous precipitate, which may conveniently be filtered and washed through a sintered glass crucible. This, on drying at 105 to 110°C. for 3 to 4 hours, changes to a semi-transparent mass of constant weight, and composition as reported by Ray Chaudhury.¹ The time of drying is not critical, but the temperature should not rise much above 120° (even at 180° iodine vapours are observed). When the above procedure is followed, the precipitation of thorium is quantitative as can be gathered from the following typical results.

Wt. in g. of $\text{ThHIO}_6 \cdot 5\text{H}_2\text{O}$ obtd.	Wt. in g. of thorium calculated	Wt. in g. of thorium taken
0.2471	0.1051	0.1055
0.2479	0.1054	0.1055
0.2368	0.1007	0.1008
0.2357	0.1002	0.1008

Thorium periodate precipitate is soluble in dilute mineral acids and can accurately be estimated volumetrically in the following way:—the washed precipitate is dissolved in dilute hydrochloric acid and a slight excess of potassium iodide is added. The iodine liberated is titrated against standard thiosulphate. One atom of thorium corresponds to one periodate group or eight equivalents of thiosulphate. The following example will illustrate the accuracy of the volumetric estimation 0.1055g. of thorium was taken. The estimated values were 0.1047, 0.1048, 0.1050 and 0.1052.

An interesting property of the periodate precipitate is that while it ordinarily retains five molecules of water of hydration, on prolonged desiccation (3 weeks) in vacuum over caustic potash, a part of this water is lost and its final composition corresponds to $\text{ThHIO}_6 \cdot 4\text{H}_2\text{O}$.

Work on the use of periodates in the separation of thorium from cerium earths is in progress.

M. VENKATARAMANIAH.

BH. S. V. RAGHAVA RAO.

Andhra University,
Waltair,
February 22, 1949.

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A NEW SYNCHYTRIUM ON PHASEOLUS MUNGO

A VERY severe disease on *udid* (*Phaseolus mungo* L.) causing defoliation was noticed on the Government Farm, Jalgaon, East Khandesh in August, 1948. A reference through literature showed that no species of *Synchytrium* was reported so far on this plant and that those reported on other legumes differed a great deal and hence it is proposed to assign it a specific rank.

Synchytrium phaseoli Patel, Kulkarni and Dhande sp. nov.

Leaves are covered on both sides with quadrilateral to polygonal crusts, measuring $1-2 \times 1$ mm. when quadrilateral. Several crusts when limited by veins coalesce. Colour of crust on the upper surface is deep-brown while it is pale brown on the lower surface. Infection occurs rarely on petioles.

Resting sporangia many in a crust, but one in each host cell, spherical to slightly ellipsoidal, smooth, with thick dark brown wall, measuring $18.0-26.6 \mu$ (average 22.8μ) in diameter. Endospore spherical, olive brown, smooth, thick walled, 3.5μ thick epispore.

On leaves and petioles of *Phaseolus mungo* L. (Urd bean), Jalgaon, India, August 1948.

The authors are thankful to Rev. Fr. H. Santapau, S.J., of St. Xavier's College, Bombay, for the following Latin rendering of the description.

Synchytrium phaseoli Patel, Kulkarni and Dhande pec. nov.

Foliorum utraque facies cooperta costris quadrilateralibus vel polygonalibus, quadrilateralibus quidem $1-2 \times 1$ mm. magnit. Plures costræ, cum venis limitantur, coalescunt. Costrarum color in facie superiore est fusce brunneus, in inferiore vero facie pallide brunneus. Infectio raro in petiolis invenitur.

Sporangia quiescentia plura in singulis costris, sed singula occurrunt in singulis plantæ hospitis cellulis. sphærica ad tenuiter ellipsoidea, levia, crassis et fusce brunneis parietibus ornata, magnit. $18.0-26.6 \mu$ (mediet. 22.8μ) in diam. Endosporium sphæricum, olivaceo-brunneum, leve, crassis parietibus præditum; epispodium 3.5μ crassum.

In foliis et petiolis *Phaseoli mungo* L.

(Urd bean), in loco Jalgaon, India, mense augusto 1948.

Plant Path. Laboratory, M. K. PATEL.
Agricultural College, Y. S. KULKARNI.
Poona, G. W. DHANDE.
January 15, 1949.

A CASE OF SIMULTANEOUS MUTATION OF TWO INDEPENDENT GENES IN THE CHILLI CAPSICUM ANNUUM L.

THERE are several cases of spontaneous mutation involving a single gene, but cases of simultaneous mutation of two or more genes occurring spontaneously are perhaps rare. A case of simultaneous mutation of two independent genes, one determining the colour of ripe fruit and the other plant habit, has been recorded in the chilli crop in this Division. The colour of ripe fruit, red or yellow, is only a varietal difference, the bulk of the commercially grown chillies being red fruited. In the chilli collection in this Division both red and yellow fruited varieties are present. As regards compact plant habit with fruits appearing in clusters no variety in the collection of this Division possessed these characteristics, nor is the author aware of the existence of such a variety. A plant with such characteristics, which arose as a mutant, was first observed in this Division and described as "Bunch" mutant (Deshpande, 1940).

Genetical investigations in this crop have shown that red colour of fruit is a single dominant to yellow and normal plant habit dominant to compact habit (Deshpande, 1933, 1941).

In the year 1943-44 in the progeny of a single, unselfed plant of N. P. 34, which has red fruits and normal plant habit (Shaw and Khan, 1928), plants with compact habit and plants with yellow fruits also were observed. On taking counts the frequencies were found to be as follows:—

	Normal habit		Compact habit		Total
	Red fruited plants	Yellow fruited plants	Red fruited plants	Yellow fruited plants	
Frequencies observed	12	3	4	1	20
Frequencies calculated on 9:3:3:1 ratio	11.25	3.75	3.75	1.25	20

It may be seen from the data that the agreement between the observed and the theoretical frequencies on the basis of two factor difference is very close.

That this segregation is not the result of a natural cross with the "bunch" mutant recorded earlier (Deshpande, 1940) or with a yellow fruited type is evident from the fact that the fruit size and shape in all the plants of the segregating progeny were uniform, whereas the "bunch" mutant referred to above has much longer fruits, besides being red fruited and the fact that no yellow fruited type in the collection has the size and shape of the fruits of the mutant.

This therefore is a clear case of two independent dominant genes mutating simultaneously to their recessive condition. The parent plant of the segregating progeny of N.P. 34, which had normal plant habit and red fruits, must have been heterozygous for the two genes controlling the two characters involved. This heterozygous condition may have resulted from the mutation of the dominant alleles for normal habit and red colour of ripe fruit.

From this segregating progeny pure breeding plants with compact habit and red and yellow fruits respectively have been isolated and added to the collection of chilli varieties maintained at this Division.

Indian Agricultural Research Institute,
New Delhi,
March 7, 1949.

R. B. DESHPANDE.

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INDEX FOR EARLINESS IN SUGARCANE

RIPENING in sugarcane is a vegetative process unlike in the case of grain crops in which latter sexual processes are involved. In the former, ripening is largely season bound but the degree of ripening depends upon the age of the shoot, soil and climatic conditions. Active growth of sugarcane more or less coincides with the monsoon periods, and ripening starts with the slackening of growth and the onset of cold dry months. There are varieties which ripen early or late. Thus, ripening may

be said to be a resultant of the external as well as internal factors.

Among the external factors which bring about ripening may be mentioned (i) Soil type, (ii) Soil moisture, (iii) Fertility status of soil, (iv) Manures applied and (v) Cultural practices. There is abundant literature discussing the effects of these factors on ripening, and hence for the sake of brevity they are not mentioned here.

Regarding the internal factors very little work has been done. Study of varietal differences in regard to earliness and degree of ripening have been a regular feature of the work of Sugarcane Research Stations everywhere. Clement and Kubota (1943) from Hawaii studied the problems of primary index and fixed upon the total sugar level of the elongating cane sheaths expressed as per cent. of dry matter. But Borden (1945) reported wide range of variability of this primary index from his studies on replicated plots. Hartt (1939) and Clements and Kubota (1942) have reported on the moisture contents of sugarcane. These authors discussed the moisture content in different parts of the plant and the elongating leaf-sheath was chosen as reliable tissue to be used as moisture index.

Growth of cane by dry weight method was recorded by me in respect of two replicated field experiments at Anakapalle during the season 1948-49. Fortnightly increases in dry matter and moisture % in leaf, sheath, growing spindle and stem were recorded from July to February. The variants in the two aforesaid experiments are: *Ratoon experiment*:—Variety Co. 419. (a) ratoon crop, (b) plant crop. *Monthly planting experiment*:—(a) Co. 419 planted in the months of (i) March, (ii) April, (iii) May, (iv) June (b) Co. 475 planted in the same months as Co. 419. The data collected are too elaborate to be reported here but data for two typical periods are furnished below (see Table),

A perusal of the entire mass of data shows that the moisture content is closely associated with the ripeness of cane. Corresponding analysis of juice was not done for obvious reasons that such a correlation was not anticipated before. But this correlation is inferred from the fact that ratoon crop and Co. 475 on one hand and the earlier plantings in the case of varieties on the other, are earlier in maturity than the plant crop and late plantings respec-

Date of sampling	Variety	Month of planting	Moisture content as % on wet basis			
			Entire plant	Green leaf	Sheath	Stem
14-9-48	Co. 419 : Ratoon Plant	March	79.41	69.64	81.85	84.22
		"	81.94	71.27	85.86	85.37
31-12-48	Co. 419 : Ratoon Plant	"	70.24	63.26	78.88	74.52
		"	74.61	65.67	81.17	77.45
30-8-48	Co. 419	March	79.83	66.41	85.76	84.52
		April	83.07	68.24	84.63	87.75
		May	84.87	71.98	86.46	89.27
		June	81.30	73.76	85.70	88.67
	Co. 475	March	77.29	64.61	78.28	79.77
		April	78.24	67.00	78.85	82.38
		May	82.97	70.03	83.33	87.58
		June	82.02	71.40	84.02	90.59
10-2-49	Co. 419	March	70.19	63.52	76.67	73.87
		April	71.64	61.33	76.69	73.68
		May	73.21	63.27	72.65	74.41
		June	74.45	64.34	75.50	77.14
	Co. 475	March	67.35	58.48	73.01	67.50
		April	68.92	60.38	73.36	70.27
		May	68.08	64.12	74.98	72.86
		June	68.70	62.81	74.12	69.89

tively. Moisture content in plant parts falls progressively as the cane matures. The moisture % is subject to fluctuation to some extent on the soil moisture and climate, but more mature canes and the early maturing varieties proportionately record less moisture than the corresponding controls. This establishes a close relationship between earliness of cane and the moisture content of the tissues.

To further test this point, which occurred to me late in the season, moisture content in 4 important varieties in short crop stage was studied and the data are reproduced below:—

Variety	Moisture %			Remarks
	Leaf	Sheath	Stem	
Co. 527	68.22	79.57	82.36	Early variety
Co. 449	70.48	76.75	79.47	Mid season
Co. 475	70.58	82.09	83.87	
Co. 419	71.64	82.71	85.56	Late variety

Further tests in progress in my laboratory confirm the above relationship.

The following conclusions are possible:—

1. Even when the soil is in its maximum moisture-holding capacity, varieties exhibit characteristic differences in the moisture in the different plant parts.

ences in the moisture in the different plant parts.

2. The maximum moisture holding capacity of the tissues is closely associated with the earliness and richness of cane.

It is therefore hypothesised that earliness is inversely related to the moisture-holding capacity of the tissues.

Many of the agronomical findings recorded so far in various Research Stations can be explained in terms of this new hypothesis: to mention a few examples (1) withdrawal of water from soil hastens maturity, (2) dry climate hastens maturity, (3) high dosage of N delays maturity, (4) porous soil hastens maturity, (5) shallow root system hastens maturity.

Under all these conditions, the plant is likely to be forced to retain less moisture in its tissues.

This finding opens up the possibility of testing the earliness or richness of cane, now that the prime factor for richness of juice and earliness are known in seedling stage itself. There is great scope to devise agronomical practices which will hasten maturity.

Further details of this hypothesis on the maturity of sugarcane and its importance in both cane breeding and cane agronomy are under detailed study on this station.

The data reported here form part of Sugarcane Research Scheme subsidised by the Indian Central Sugarcane Committee to which body my grateful thanks are due.

S. V. PARTHASARATHY.

Sugarcane Res. Station,
Anakapalle,
March 12, 1949.

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NOTE ON THE OCCURRENCE OF THE WEEVIL *DIOCALANDRA STIGMATI- COLLIS* GYLL., AS A PEST OF THE COCONUT PALM IN TRAVANCORE

SPECIES of the Curculionid, *Diocalandra*, have been recorded as pests of the coconut palm from several parts of the Oriental and Australian regions. According to Hermes,¹ *Diocalandra taitensis* Guerin., bores into fronds, trunks, spikes, spikelets, and young

nuts, and causes total loss of nuts, when larvæ attack spikelets. Tailor² observes that this pest breeds in any part of the plant that has been injured by other causes and has begun to decay. Jepson³ recorded *D. frumenti* F. for the first time from Ceylon in 1923, but Fletcher⁴ who observed it earlier in India, in 1913 reported large trees having been killed by this pest. There has been no further mention about any of these weevils, from India.

In the summer of 1947, the writer came across a dozen trees infested by larvæ and adults of *Diocalandra stigmaticollis* Gyll.,* in a coconut plantation near Quilon, at the mouth of a small rivulet which empties itself into the Nadayara backwater. The soil of the place is of the alluvial type, rich in humus, and the entire area is subjected to flooding in the monsoon, and to water-logging during the rest of the year. The plantation contained about 700 trees, all under twelve years of growth. In the affected trees, one or more of the entire leaves, or parts of it, presented a blackened, scorched, and shrivelled appearance. In the initial stages of attack, the fronds were green and healthy, but grubs were seen in numbers, infesting the mid-ribs of these green fronds. In more advanced stages,

secretion of the colour and consistency of thick molasses. The cavities were just large enough to hold a full-grown larva, but neither dead nor live stages of any insect were present in them. In the last

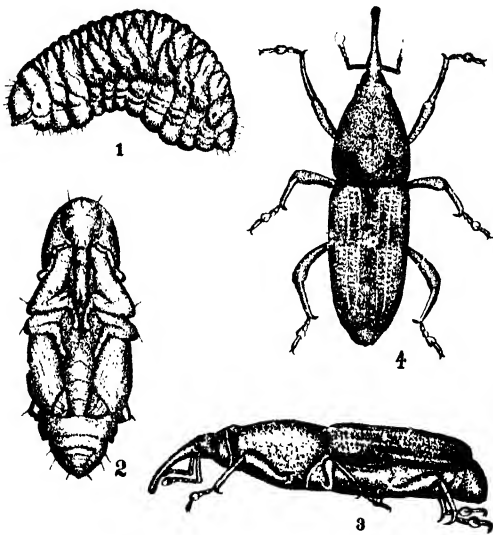


PLATE 1. Showing stages of *Diocalandra stigmaticollis* Gyll.

1. larva. 2. pupa. 3 & 4. adult. $\times 10$.

small cavities were present in the mid-rib ; these cavities being filled with a resinous

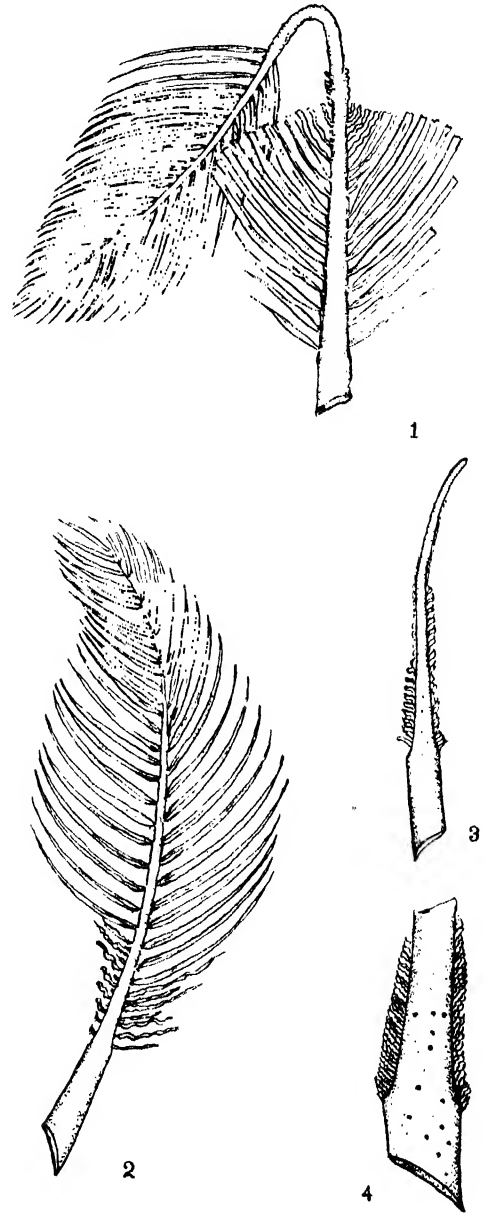


PLATE II. Coconut fronds showing damage by *Diocalandra stigmaticollis* Gyll.

1 & 2. Showing partial damage.

3. Complete damage.

4. Near view of basal portion showing exit holes of weevils.

stages of attack, the entire leaf had dried up, and the basal portion of the mid-rib showed numerous exit holes of adult weevils. Two trees which had the worst attack, had the young fronds and spikes very badly affected and the nuts in the older spikes were small and malformed. These trees were rendered so useless that they had to be cut down.

The insect responsible for this damage, is a small weevil, dark tan in colour, with a faint dark patch on the prothoracic region. It is about 6 mm. long, and 1.5 mm. broad across the thoracic region, and the snout is long and pointed, with a gentle inward curve. Larvæ are of a dull white colour, with the posterior half of the abdomen well developed. Repeated observations of the infested locality showed that in about three to four months, the attack lessened in vigour, and after about three to four weeks of monsoon rains, it practically disappeared.

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University of Travancore.
Trivandrum,
March 16, 1949.

* Specimens were indentified by the kind courtesy of the Forest Entomologist, Indian Forest College, Dehra Dun.

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TELIA OF THE LEAF-RUST ON TEAK

Uredo Tectonæ Racib., inciting the leaf rust of teak was first described by Raciborski¹ in 1900 from Java. The rust is widely distributed in the areas where teak is grown. Raciborski described the uredial stage of this rust, and for the last 49 years no other spore form is known in spite of the abundance of the rust in all teak plantations. The uredia are numerous and almost plaster the lower surfaces of the leaves and hasten defoliation. The damage is especially severe in nurseries where the young plants are retarded in growth due to premature defoliation.

The writer has been studying the rust for several years during which period, only uredial stage (Fig. 1) was noticed. The rust can be collected in the uredial stage all round the year, though during some months very few leaves remain on the tree due to premature defoliation. The urediospores readily infect young leaves and produce secondary uredia. A continuous watch was kept to find out the possible occurrence of telia,

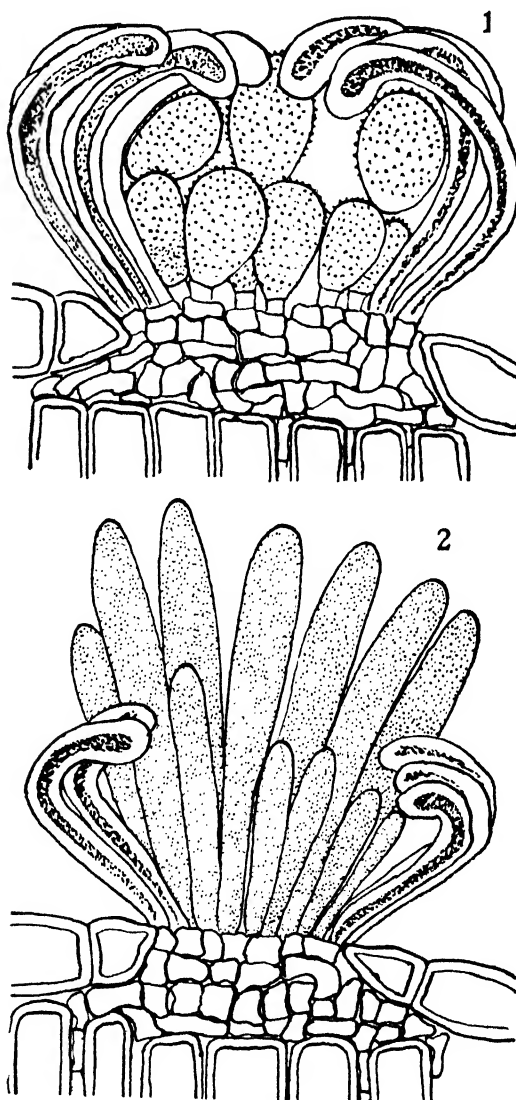


FIG. 1. Uredium $\times 750$. FIG. 2. Telium $\times 1000$.

which would throw light on the identity of the rust and help in elucidation of its life cycle.

Collections of rusted leaves made near Bangalore by middle of March, first gave the indication of a few teliospores developing within the uredia. Further collections made in early April, at a time when the trees were getting defoliated rapidly indicated the abundance of telial development. The teliospores are formed either intermixed with the uredia or produced in separate sori. Macroscopically they are indistinguishable from the uredia, as they have the same golden-yellow colour. This probably explains the telia being overlooked for so many years.

The telia are subepidermal, golden-yellow, and have the same sorus structure as the uredia. In their formation, strands of hyphae are first grouped in the substomal space. The guard cells are pushed apart widely, and the plectenchymatic mass of hyphae protrude above the epidermis and form the sorus. The paraphyses are marginal, cylindric, incurved, free at the apex

and coalescent at the base. They have orange-yellow contents. The teliospores are cylindric to fusiform, thin walled and sessile. They are produced in clusters on laterally free sporogenous basal cells. In early stages the telia are covered by the marginal, incurved paraphyses which later on due to teliospore elongation and germination are pushed apart and can be seen only at the base (Fig. 2). The teliospores germinate immediately at maturity developing a long four-septate promycelium, bearing globular sporidia on sterigmata (Fig. 3).

As regards the identity of the rust, the structure of the uredia and telia indicate relationship to *Olivea* Arth. The genus *Olivea* proposed by Arthur¹ with *O. capituliformis* (Henn) Arth., as type, includes three species of which *O. Petittiae* Arth., and *O. Scitula* Syd., occur on Verbenaceous hosts. Arthur described all the spore forms as being subcuticular, but Dietel² contested that the uredia and telia are subepidermal. A careful examination by the writer of *O. capituliformis* deposited in Arthur Herbarium, Purdue University (F 2175) confirmed the findings of Mains³. The compact masses of mycelia are grouped in the substomal space, and the urediosori and teliosori are first subepidermal and later formed above the epidermal surface. They appear therefore superficial, and are similar in the type of development, to *Crossospora zizyphi*² (Syd. and Butler) Syd., and species of *Prospodium*¹. The uredia and telia of the teak leaf rust have the same sorus structure and are surrounded by incurved paraphyses which are yellow in the early stages on account of orange-yellow contents but appear hyaline later on. The occurrence of coloured, incurved paraphyses forming a nest-like structure is characteristic of *Olivea capituliformis*. In the teak leaf rust, the paraphyses while having the same general structure are not so prominently developed to give a nest-like appearance. The genus *Tegillium* described by Mains⁴ for a rust on *Vitec* closely resembles *Olivea* but differs in having subcuticular telia. Discovery of the telia for the teak leaf rust indicates that it is a species of *Olivea*, with the following characters:

Olivea Tectonae (Racib.) Thirum. comb nov.
Uredo Tectonae Racib.

Uredia hypophyllous, subepidermal, developing sori above epidermis, orange-yellow, erumpent, and pulverulent, paraphysate;

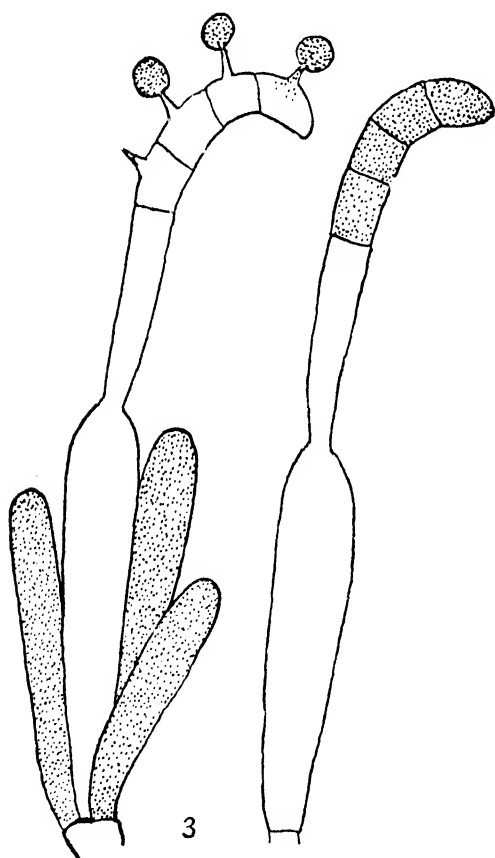


FIG. 3. Germinating teliospores $\times 1250$.

paraphyses marginal, cylindric, incurved, coalescent at the base with orange-yellow contents, wall upto 2.5μ thick, swollen at the tip; urediospores orange-yellow, ovate-ellipsoid, densely echinulate, $20-27 \times 16-22\mu$ with indistinct germ pores.

Telia developed within the uredia, or separately, subepidermal, developing sori above epidermis orange-yellow, paraphysate, paraphyses same as in uredia, covering the sori in early stages, later naked; teliospores clavate, fusoid-clavate, sessile, borne in clusters on basal cells, with orange-yellow contents, $38-51 \times 6-9\mu$, wall hyaline, thin; spores germinating intrasorum at maturity; promycelium external, four-celled, bearing globular sporidia.

Hab. On the leaves of *Tectona grandis*, Bangalore, India 7-4-1949, leg; M. J. Thirumalachar.

M. J. THIRUMALACHAR.

Bangalore, South India.

April 12, 1949.

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THE OPTIMUM pH OF

CLOSTRIDIUM LACTO-ACETOPHILUM

THE unsuitability of the routine turbidometric method alone has resulted in reporting the "good growth" range for *Cl. lacto-acetophilum* as pH 6.2 to 7.4.¹ Whilst this information is adequate for one interested in further work on this clostridium, it fails to point out the optimum pH and leaves one to guess as to which of the two figures referred to above approaches the optimal value. The difficulty of determining the optimum pH in this instance arises from the fact that the pH of the lactate medium in which this organism is grown goes on increasing as the lactate ion gets decomposed. An attempt was therefore made to determine the optimum pH of this organism by resorting to a combination of methods, viz., measurement of growth and measurement of physiological activity, and the results obtained are reported here.

The experiments were done with *Cl. lacto-acetophilum*, strain No. 3. The basal medium contained the following compounds

in grams per 100 ml. of distilled water: Sodium lactate, 1.0; yeast autolysate, 0.3; sodium acetate, 0.8; sodium thioglycollate, 0.05; $MgSO_4 \cdot 7H_2O$, 0.01; $(NH_4)_2SO_4$, 0.05; $FeSO_4 \cdot 7H_2O$, 0.002, and $CaSO_4 \cdot 2H_2O$, 0.001. With acid and alkaline phosphates the pH in each tube was adjusted to a different level so as to obtain a range varying from 6.20 to 7.55 within which the optimum was sure to be recorded. The several tubes containing the medium were autoclaved and then each tube was inoculated with 0.1 ml. of a 48 hrs. old culture. The tubes were sealed to obtain anaerobic conditions by the use of potassium carbonate-pyrogallol seal and incubated at $37.5^\circ C$. after the initial turbidity in each tube was determined by the use of a colorimeter. Growth appearing in the tubes was measured the same way every few hours and after 6 days (when the growth had ceased) the contents of each tube were analyzed for the undecomposed lactate as well as the butyrate formed, the latter being the characteristic product of the organism. The methods adopted for the analyses have been referred to before.^{1,2} Table I gives the typical results obtained.

TABLE I

pH	Relative growth	Time in hrs.	Lactate decomposed mM/100 ml.	Butyrate formed mM/100 ml.
6.20	1010	98	8.50	4.13
6.50	1367	117	8.70	4.65
6.80	1264	117	8.50	4.65
7.10	996	98	8.41	3.60
7.35	757	94	7.81	3.57
7.55	446	94	7.60	3.27

The results would seem to indicate that from the maximal turbidity view-point (which appeared in 117 hrs.) as well as from the point of view of the decomposition of lactate with consequential formation of butyrate, a pH of 6.5 would approach the optimal for this organism. At the same time, if we take the formation of butyrate alone as the criterion for maximal metabolic activity, then two pH values, viz., 6.5 and 6.8 would appear to be equally suitable. If, on the other hand, we accept the early appearance of "good growth" as our criterion (and this organism grows well in about 48 hours) for the optimal, then 6.8 would appear to be indeed the right pH value; for the turbidometric measurements made after 26 and 46 hours

of incubation (see Table II) gave unmistakable evidence in favour of this conclusion.

TABLE II

pH	Relative growth	
	26 hrs.	46 hrs.
6.50	482	969
6.80	617	996

From the above considerations it is abundantly clear that the optimum pH of *Cl. lacto-acetophilum* is 6.8, or a point exactly midway between the "good growth" range of 6.2 and 7.4.

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Bombay,
April 7, 1949.

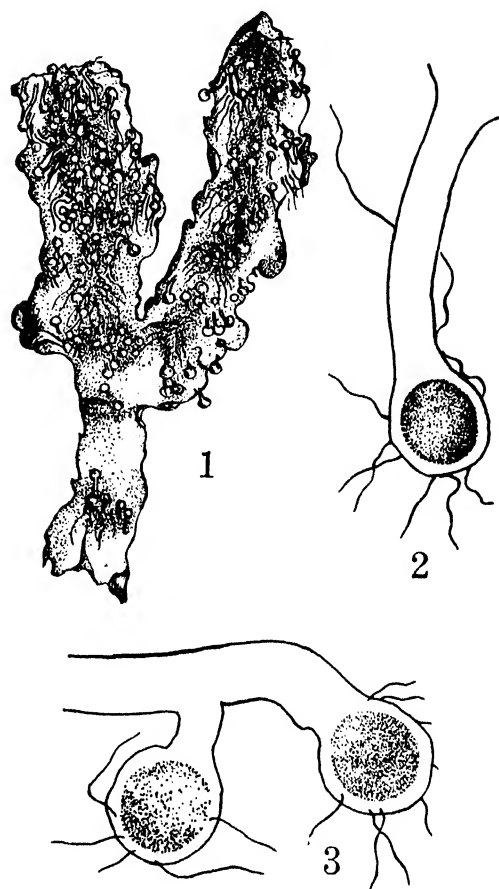
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TUBERS IN A SPECIES OF *ANTHOCEROS*

COLLECTIONS of an *Anthoceros* species made in the Bababudangiris, Mysore, in the month of September 1948, showed that the thalli were dichotomously branched and possessed slender, long, greenish sporophytes, with stomata on their outer walls, and conspicuously elongated epidermal cells. The spores were echinate, purple black in colour and interspersed with elaters. The latter were multiseptate with a hump as in *Anthoceros erectus* Kashyap.

Observations revealed the presence of large numbers of tuberous outgrowths on the undersurface of the thalli, springing from the margin as well as the midrib (Fig. 1). In the initial stages these tuberous structures developed as small cushion-shaped bodies, later being surmounted on a long stalk (Fig. 2); sometimes two such tubers were borne on the same stalk (Fig. 3). The occurrence of such tubers has been reported in *A. dichotomus*, *A. argentinus*, *A. tuberosus* (Goebel,¹ 1905) and *A. himalayensis* (Kashyap,² 1929, p. 26). In *A. dichotomus* the tubers stand on the underside of the thallus, mostly on the sterile parts. In *A. argentinus*, on the other hand, partly lateral and partly ventral shoots, darker in colour, become transformed into tubers. In *A. himalayensis* the tubers are generally

borne on the sterile plants at the apex, margin, ventral surface, and also on the



FIGS. 1-3. Tubers in an *Anthoceros* sp.

Fig. 1. A thallus showing numerous tubers on the ventral surface. $\times 3$. Figs. 2 and 3 Tubers with stalk. $\times 45$

male and female thalli occasionally. As a rule they are stalked but are found embedded sometimes in the thallus.

Microscopic examination of the tubers revealed the following structural details (Fig. 4). The central core of cells were orange yellow and filled with oil globules. The outer enveloping layers were composed of two to three layers of hyaline cells. Some of these outer cells elongated into unicellular rhizoids. These were also seen to arise from the outer cells of the stalk, especially at their point of origin. Goebel (1905) reported similar cases of development of rhizoids in *A. dichotomus*.

Since viable material was not available

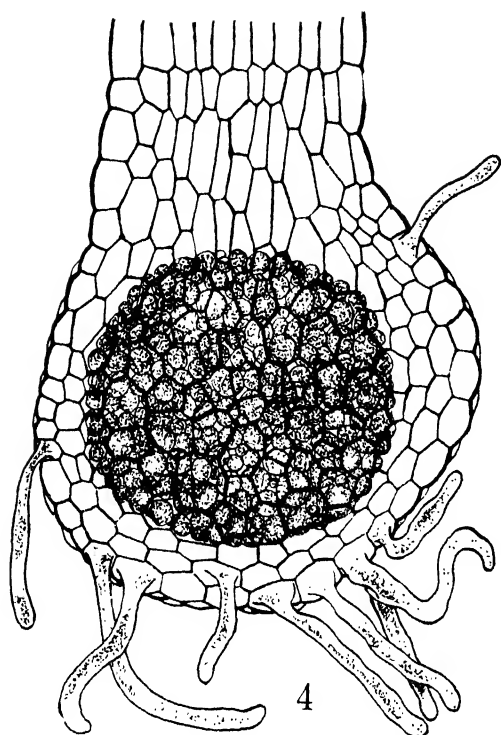


FIG. 4. Tubers in an *Anthoceros* sp. A tuber magnified to show the lighter contents of the cortical cells and the translucent storage cells in the centre and the rhizoids. $\times 196$.

germination experiments were not carried out in the present study to further elucidate the nature of the tubers. Goebel (1905) suggested that they may be of the nature of vegetative reproductive structures. He further regarded them as being transformed branches of the thallus whose ends have become swollen and filled with reserve food materials. So far as our present observations go we are inclined to accept this view of Goebel.

The writers wish to thank Dr. L. N. Rao, Bangalore, and Dr. T. S. Mahabale of Bombay, for valuable suggestions.

Dept. of Botany, K. SUBRAMANYAM.
Central College, B. A. RAZI.
Bangalore,
December 21, 1948.

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TWO ECTOPARASITES OF THE BAT *ROUSETTUS LESCHENAUULTI* DESM.

DURING our studies on bats in the island of Bombay, we came across a number of ectoparasites which are being studied here. Of particular interest were two Nycteribiids and Streblids (Diptera) which do not seem to have received enough attention in the past.

Phillips⁵ recorded some wingless Nycteribiids from frugivorous bats of Ceylon, but he did not get any Streblids. Thompson⁶ also recorded a number of these parasites from bats in India. MacCann⁴ has reported both these families from bats in and around Bombay and our results confirm his observations.

The anatomy of these interesting parasites has been worked out largely by Jobling^{1,2,3}. Very little work in this direction has, however, been done in India on these insects. The anatomy of these parasites is being studied here and the interesting results will be published elsewhere.

These two insects have been identified to be *Eucampsipoda hyrtli* Kolenati and *Nycteribosca gigantica* Speiser. They were collected from the wing membrane and the neck region of *Rousettus*.

Apart from the well-developed piercing mouth parts, there is a well-developed antennal gland with a number of branches. The thoracic segments, though varying in size, are heavily padded with stiff bristles. The legs have sensitive pads on the last tarsal joint, followed by a sharp bent claw. The appendages are so adapted that they could be tucked below the body in times of need. The first abdominal segment bears comb-shaped ctenidia. The end segments are telescoped. The entire body is padded with stiff bristles and also a coat of thin hairs. The shape and locomotion are a perfect adaptation to the ectoparasitic mode of life.

We are thankful to the authorities of the Zoological Survey of India for identification of the parasites and to Dr. P. J. Deoras for valuable suggestions.

Department of Zoology, D. V. BAL.
Royal Institute of Science, F. AHMED,
Bombay,
April 17, 1949.

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2. —, *Ibid.*, 1928, **20**, 254. 3. —, *Ibid.*, 1929, **21**, 417. 4. MacCann, C., *J. Bombay Nat. Hist. Soc.*, 1934, **37**, 1002. 5. Phillips, W. W. A., *Ibid.*, 1922, **28**, 448. 6. Thompson, G. B., *Ent. Month. Mag.*, 1935, **71** (Ser. 3:21), 143.

A NEW PLOUGH FOR INDIAN CULTIVATORS

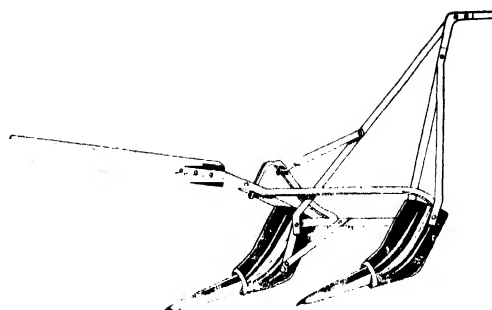
A NEW plough, which may well go a long way to solving the important function of timely cultivation in the field of agriculture has been designed by the Agricultural Engineering Division of the Indian Agricultural Research Institute, New Delhi.

In the course of experimental work it was discovered that the draught of two similar country ploughs coupled together in a certain way fell considerably short of that required for a single plough of the same design. As a result of this factor it was immediately decided to investigate the possibility of designing a double Desi plough capable of operation by a single average pair of bullocks.

The new plough as finally designed is simple in construction and consists of the bottoms only of standard Desi ploughs, suitably coupled together by means of an angle iron frame work and pulled by a single central beam. The ploughs are so spaced in relation to each other that identical furrows are cut and carry out in one operation similar work as would be performed in two operations by a single standard plough.

This new plough is comparatively light, its weight being approximately 50% heavier than a single plough; thus an average ploughman can easily lift and carry it as required for ordinary operational purposes. The draft is, as already stated, tolerable, as instanced by trials in hand dry land, ploughing $4\frac{1}{2}$ "–5" deep, and using local Delhi plough bottoms the draft did not exceed 260 lbs. The draft of a single similar plough under identical conditions was 155 lbs. It may be of interest to note that the draft of a single 'VICTORY' bullock drawn soil inverting plough under average conditions varies between 320–400 lbs.

The merits of the new plough are obvious. Bullocks, in many instances and so far as ploughing is concerned are under-loaded and based on observations made on bullocks when operating 'Victory' plough and single Desi plough there is considered little doubt that this plough is capable of being operated by a single pair over considerable area in this country without undue extra effort and its daily output will be practically double. Taking an extreme where due either to soil conditions or



capacity of bullocks it is only possible to operate for 3 or 4 hours instead of 6 or 8, that is for only half of the usual daily working period, the out-turn of work will be similar as for a full day and the cultivator given extra time for relaxation or alternative work. In the case of a further extreme when soil conditions make the operation of the new plough impossible, this could be done as before with a single plough and subsequent second and third operations done in half the time with the new plough.

Quality and regularity of ploughing must automatically be improved.

Seasoned ploughmen who have used the new plough are enthusiastic about it and state that in operation it is easier and less tiresome to handle due to its 'stableness' when in work or simply—it works itself.

When in production it is estimated that its cost will not exceed, that of a single plough by more than 50%. Thus it will be cheap. It is simple in construction and easily repaired or even constructed by the village blacksmith or carpenter and may well prove to be of great value in the effort being made to-day to increase food production and at the same time ease and improve the work of the Indian cultivator.

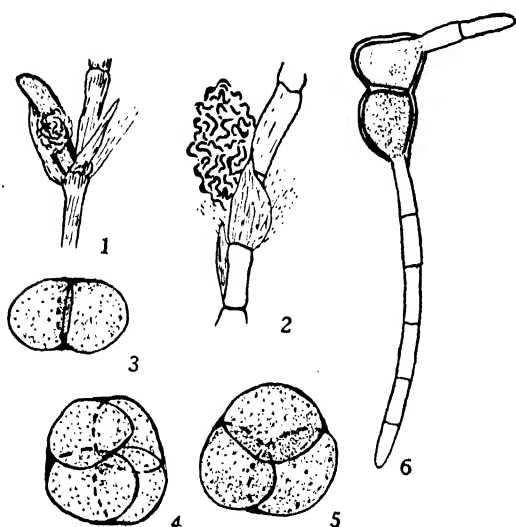
I.A.R.I.,
New Delhi,
April 20, 1949.

D. T. BROWN.

CEREBELLA ON SUGARCANE

DURING the course of taxonomic studies of the sugarcane flower in the material collected in Hebbal, Bangalore, large numbers of spikelets were seen parasitised by a *Claviceps* species, which was similar to that reported by Thirumalachar² from Mysore.

A *Cerebella* species closely agreeing with the descriptions of *Cerebella andropogonis* Ceasti. was found to inhabit sclerotial development of *Claviceps* on sugarcane and convert them into greenish-black cerebriform stromata (Figs. 1 & 2). The conidia (Figs. 3, 4 & 5) of the *Cerebella* were present in large numbers.



FIGS. 1 & 2. Showing the *Cerebella* on ergotised spikelets ($\times 5$ & $\times 7$ respectively).

FIGS. 3, 4 & 5. Conidia. $\times 1800$.

FIG. 6. Germination of conidium. $\times 1,800$.

Langdon¹ gives a good discussive account of the biologic status and use of *Cerebella* species studied by him in Australia. Even so in the present study, the *Cerebella* was noticed to be making saprophytic growth on the spahacial stage of the sugarcane ergot, partially suppressing the sclerotial stage that would follow in normal development. Venkatarayan² reports the presence of a sooty mould inciting the folded, cerebriform type of development in the ergotised spikelet of sugarcane in Mysore. The fungus which was identified by him as *Coniothecium* species may be only *Cerebella*. The presence of *Cerebella* is a good field indicator of the ergot.

The conidia of *Cerebella* readily germinated in water developing septate germ tubes (Fig. 6). The fungus was not grown in pure culture, but Langdon¹ reports dark cerebriform stromatic growth of the fungus on potato-dextrose agar.

Grateful thanks are due to Prof. P. H. Rama Reddy for kind guidance and encouragement and to Dr. M. J. Thirumalachar for valuable suggestions.

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Hebbal, Bangalore.

H. C. GOVINDU.

March 16, 1949.

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NOTE ON A "SCHORLITE-PENNINITE" ROCK FROM SHIMOGA DISTRICT, MYSORE STATE

DURING the course of a visit to some parts of Shimoga district, an interesting variety of Tourmaline-Chlorite rock has been noticed at Kagehalla dam site near the sixth mile stone along Bhadravati-Chennagiri road. On detailed examination the Tourmaline is seen to be Schorlite, and the chlorite, Penninite. Further, since it showed an interesting mode of occurrence a detailed mineralogical study of the rock has been made.

The P.W.D. channel section from the dam site reveals the relationship of the rock types of the area. At the fourth furlong of the fourth mile, the country rock—namely serpentinised Dunites (ultra-basic member of the Dharwars) are seen enclosing lenticular xenoliths of Hornblende Schist of various sizes. A large number of pegmatite veins of the associated Shimoga granites are also seen showing intrusive relationship with these Serpentinised rocks. It is along the contact of these Pegmatites and the serpentinised rock that the Schorlite-Penninite rock has been noticed. It has developed in a vertical zone parallel to the pegmatites and invariably bordering them often-times showing a width of a foot or two, like dark felted masses.

The rock is brittle, compact, fairly hard, heavy, with a specific gravity of 3.2. It is made up of coal black Schorlite and pale green Penninite. Schorlite constitutes the major bulk of the rock occurring in radiating and sheaf-like aggregations of rods and needles varying from 0.1 cm. to 1 to 1.5 cm. in length and 0.1 cm. to 0.3 cm. in width. Penninite occurs as fibrous aggregates in between Schorlite crystals.

Under the microscope, the rock shows only Schorlite and Penninite without any grains of Quartz or scales of Mica. Schorlite

appears as intensely Dichroic transversely cracked prisms and intense blue polygonal or rounded isotropic plates, representing basal sections, containing irregular black inclusions of various sizes. Pale green to colourless Penninite occurs as fibrous, fan-shaped or plucky aggregations in between the Schorlite crystals often containing brownish small irregular inclusions. Generally the prismatic sections and sometimes the basal sections of Schorlite show peculiar sieve-like intergrowth structure with Penninite.

The Schorlite and Penninite show the following optical characters.

SCHORLITE

$\omega = 1.665$. $\epsilon = 1.625$
 $\omega - \epsilon = 0.040$
 $\omega =$ Intense or Prussian blue
 $\epsilon =$ Pale pink to colourless.
 Absorption $\omega > \epsilon$
 Elongation — ive
 Sign — ive

PENNINITE

(+) X = Y = Pale Green
 Z = Colourless
 Absorption X = Y > Z
 Elongation — ive
 Nm 1.585
 Ng — Np 0.000
 Ultra-blue interference colour.
 Passes off from almost Uniaxial to Biaxial.

This Schorlite differs from those described by Winchell¹ Jewell, J. Class², W. F.

Jenkins³ and Pichamuthu⁴ in its maximum birefringence and distinct Dichroism, and may belong either to Dravite-Schorlite or Schorlite-Elbaite series. With reference to refringence, birefringence and Dichroism it may be inferred that in either case it will belong mostly to the Schorlite end. A chemical or an arc spectrum analysis may substantiate the inference.

The Penninite closely resembles in its optical characters with the description given by Winchell⁵, and plotted on the diagram suggested by him for chlorite minerals⁶, yields $(At + Dn)_{17}$, $(FeAnt + Dn)_{17}$, $(Ant + FeAnt)_{58}$, $(Ant + At)_{83}$ which closely corresponds with the range for Penninite given by him $(At + Dn)_{50-40}$, $(FeAnt + Dn)_{0-20}$, $(Ant + FeAnt)_{80-60}$, $(Ant + At)_{70-80}$ when resolved in terms of the end members of the Chlorite system, Amesite 31.86%, Antigorite 48.14%, Daphnite 7.14%, and Ferro-Antigorite 9.86%. Total 100.00%.

Since the rock is an unusually interesting type, further studies are in progress and a fuller paper will be published elsewhere.

C. GUNDU RAO.

Dept. of Geology,
 Central College,
 Bangalore.
 May 4, 1949.

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COURSES ON INDIAN PHILOSOPHY AT ASIA INSTITUTE IN NEW YORK

PROFESSOR P. T. RAJU, of the Department of Philosophy of Andhra University, South India, will offer a seminar in Indian philosophy for graduate students and a general course on contemporary Indian philosophy at the Asia Institute in New York, beginning October this year. The professorship has been made possible for one year through a special grant of funds from the Tata Trust of Bombay. This is the first of visiting professorships to be set up under the Trust.

The Asia Institute maintains a school for

Asiatic Studies accredited by the University of the State of New York, and a public museum of Oriental arts and crafts, and sponsors special events for its membership.

The Institute recently announced acquisition of a 500-volume library on Indian art, formerly the property of Dr. Heinrich Zimmer, an authority on Indian art, myth, and religion, who died in 1942. Addition of the Zimmer Library brings the Institute's collection of books and journals on Asia to about 30,000.

REVIEWS

Trace Elements in Food. By G. W. Monier-Williams. (Chapman & Hall Ltd., London), 1949. Pp. viii + 511. Price 30 sh. nett.

Remarkable developments have taken place, in recent years, in canning and dehydration of meat, fruits and vegetables with the result that one meets with a wide variety of processed foods for daily consumption. Contamination of food with certain trace elements is, therefore, inevitable under these conditions and consequently there is a great need for adequate knowledge of this subject. In this book, the

ly developed for the estimation of elements like manganese and the use of radioactive isotopes in the assay of some of the trace elements.

The following additional information may be included in the book to increase its usefulness and make it an excellent volume of reference on trace elements. The importance of cobalt as an essential constituent of crystalline vitamin B₁₂, the most effective anti-pernicious anaemia factor, recently isolated needs mention. Studies carried out with radioactive isotopes of iron, copper cobalt, manganese, zinc and iodine with special reference to their de-

importance and the author has reviewed the work done on these elements in great detail. A good many of the trace elements like boron, molybdenum, selenium, lead, tin and nickel have been described with particular reference to their bearing on plant and animal life and to the diverse ways in which they gain access to food through manufacturing processes or commercial practices. The author also discusses the upper limits of concentration of these elements in foods and the existing laws with regard to their toxic levels.

For every trace element, several methods of determination have been outlined and their relative merits discussed. Most of these are colorimetric in nature and involve the use of organic reagents; gravimetric, polarographic and spectrographic methods have also been described for many of the elements. While a "general method" has been given for estimation of copper, one finds no such method of choice described in the case of other elements. This is rather unfortunate since most analytical and food control laboratories, which cannot afford a polarograph or a spectrograph would welcome from so experienced an author, one recommended method in detail, which can be easily applied for routine determinations. Besides for the sake of completeness, mention should be made of the microbiological methods recent-

conditions under which these elements can be determined by this reagent and the manner in which interfering substances eliminated.

The book on the whole is quite comprehensive and will prove invaluable to the food chemist, public health analyst and others interested in trace elements in food.

P. S. SARMA.

Summary of "Some Aspects of Television".

By L. H. Bedford, O.B.E., M.A., B.Sc., M.I.E.E., of Marconi's Research Laboratories. Cantor Lecture on Television delivered on Monday, 22nd November 1948. Published in the *Journal of the Royal Society of Arts*, Vol. XCVII, No. 4788, 11th February 1949. Pp. 180-194.

A general approach to the problem of television reveals that to reduce the multichannel information implied in visual information to a form suitable for single channel communication is one of the two major problems in television. The other one is the signal to noise ratio. A lens is capable of imaging a finite scene made up of a large number of points. Human eye is the best lens ever made. If we take the case of an average cinema picture which subtends $14^{\circ} \times 17.5^{\circ}$ at the eye, the maximum number of picture points with which we can usefully concern ourselves is 880,000.

Projected definition of an average cinema picture is of the order of 500,000 picture points. The British Television Service provides an effective definition of 82,500 picture points.

The transmission of visual intelligence was first made possible in 1883 due to the introduction of the idea of scanning by Nipkow. The principle is to substitute a large number of channels of low bandwidths by a single channel of wide bandwidth. This is done by successive glimpsing of the intelligence of the picture points scanned in some specific order. Modern methods of scanning are very much improved but the principle remains unaltered.

After briefly describing the older methods of analysing and synthesising a picture the author refers to the question of optimum number of lines for an assigned frequency band and points out that the older relation $F = \frac{1}{2} s^2 r \cdot \frac{1}{T}$ where s indicates number of scanning lines, r the aspect ratio and T the complete repetition period or frame period should be replaced by a modified relation $F_a = 0.75 \cdot \frac{1}{2} s_a^2 r \cdot \frac{1}{T}$ between an assigned frequency F_a and the optimum number of interlaced scanning lines s_a .

In the older method of scanning, the transmitting tube (analyser) provides a highly mobile light spot (of constant intensity) and a fixed photocell receives light from all points of the picture. The reciprocal arrangement of a fixed light source illuminating the whole picture and a flying punctiform photocell is made use of in Farnsworth Image Dissector. In Farnsworth Image Dissector the scene is imaged on the cathode of a photocell and the emitted photoelectrons are imaged by a magnetic field to form an electron current image which is bodily scanned past an aperture of picture point size by means of transverse magnetic fields. The electron current through the aperture constitutes the signal current.

Considering the second fundamental problem that of noise to signal ratio, we find that when this ratio is one per cent. the noise can be regarded as evanescent. In this case, the signal current should be at least equal to $10 \text{ m}\mu\text{A}$ when F is equal to 3 megacycles. To get this signal current from a photocell, illumination of 7,300 lux is required. This means that the Farnsworth Image Dissector can be used only as a camera tube for outdoor lighting conditions.

An improved sensitivity has been realised in Iconoscope by Zworykin. In the Farnsworth Image dissector, the photo current is effective only during a short portion of the cycle in

which the photo current element scans the aperture. All the rest of the photo current is wasted. But if the whole of the photoemission of the individual picture points during the frame period are stored and utilised at the time of scanning the signal to noise ratio can be very much improved. The principle of "Storage" utilised in the iconoscope has improved the sensitivity of camera tube considerably. It has been shown in Appendix 2 that in the case of non-storage method the required illumination increases with the fourth power of the number of lines while in the storage method it increases only with the square of the number of lines. In case of iconoscope illumination required varies from 20,000 to 2,000 lux depending on the efficiency of photocathode and on the depth of focus required.

The next stage of improvement is the image iconoscope in which a stage of gain is inserted prior to the scanning process. This leads to the improvement in sensitivity with this tube by a factor of about ten. Both these types of iconoscope suffer from the trouble of spurious signals due to secondary emission. This trouble known as shading has been eliminated in the Orthicon tube introduced in 1940 by Iams and Rose. This tube also has become the victim of obsolescence with the development of a more advanced type of camera tube, the image orthicon. This tube owes its success due to the combination of the following principles.

(i) Gain stage prior to scanning by use of electron image and secondary emission, (ii) use of two sided target, (iii) use of orthicon principle of low voltage scanning and (iv) use of electron multiplication of signal current. The noise to signal ratio in image iconoscope is higher than one per cent. The higher noise level is due to inefficient beam modulation at low light levels.

In conclusion, it may be said that there is as yet no perfect camera tube. All types have their various merits and limitations although the present tendencies in U.S.A. suggest the ultimate replacement of all other types by image orthicon tube.

S. K. C.

Rhenium. By J. G. F. Druce. (Cambridge University Press), 1948. Pp. 99. Price 10 Sh. 6d.

The enunciation of the periodic law by Mendelief in 1869 and the fulfilment of his predictions to the minutest details by the discovery of scandium, gallium and germanium,

set many chemists all over the world, in search of the new elements to fill up the gaps in the periodic table. The discovery of Mosley's Law of atomic numbers in 1914, gave a further incentive to look for the missing trace elements. Rhenium has a thrilling history, since its discovery was announced almost simultaneously by three sets of investigators working on various minerals in different laboratories. In June 1925 Noddack and Tacke from Germany announced their discovery of the new element by the X-ray examination of the concentrates derived from platinum and columbite ores and named the new element as Rhenium after Rheinland. During October of the same year Druce announced that the new element was found in the concentrates of manganese minerals when the manganese was precipitated as sulphide. The wavelengths of the X-ray spectrum obtained by Druce were identical with those of Noddack and Tacke and the name Rhenium was accepted. During November, Dolejsk and Heyrousky obtained polarographic curves for rhenium in manganese sulphate solutions and confirmed the presence of the element in the preparation of Druce. A prolonged controversy then followed regarding the priority of the discovery. Prandtt denied the occurrence of rhenium in columbite, while Russian men of science (Zvjagintsev and others) were unable to detect the presence of rhenium in native platinum. The work of Druce and Heyrousky was also criticised for want of accuracy.

Whatever the claims for priority may be, there is no doubt that Druce has been one of the pioneers in the field of research work on rhenium and its compounds. Coming from him, the book gives an authoritative first-hand and up-to-date information about the chemistry of rhenium and its compounds. It is very gratifying to note that references are given even to publications appearing in 1946. The book is divided into eight chapters, the first giving an introduction including the historical aspect, the second describing the isolation and properties of rhenium. The preparation and properties of the oxides, acids, halides, sulphides, selenides and thio-salts form the subject matter of Chapters III to VI. The organic derivatives of rhenium and the applications of rhenium are described in Chapters VII and VIII respectively. The book makes an interesting reading, with the author's experience in various experimental procedure. The book will be of immense value not only to the students of advanced inorganic chemistry but

also to those that are doing research work on rhenium.

M. R. A.

Elasticity of Wood and Plywood. By R. F. S. Hearmon. (Forest Products Research Special Report No. 7. Dept. of Sci. and Ind. Res. London), 1949. Pp. 87. Price 2 Sh. net.

In his valuable report Hearmon gives the results of his extensive experimental investigations along with the relevant theory and experimental results of other workers in the field. A fairly comprehensive bibliography at the end adds in no small measure to the value of the report. Such a presentation greatly aids the appreciation of the value and extent of the author's investigation in the correct perspective of existing knowledge and useful lines of further development. The nature of the subject of investigation is such as to preclude any but a very approximate agreement between theory and experiment. The application of the strict mathematical theory of elasticity developed for a homogeneous material with a definite molecular structure to a material like wood or plywood consisting as it does of a heterogeneous conglomerate of different molecular varieties subject to random variations due to fluctuations of growth conditions, takes one far into the realm of extrapolation of exact knowledge.

A few salient points in the report are worth mentioning. Hearmon reports that in going from the static method to a dynamic method of frequency about four cycles per second, the elasticity shows a rise of about 20%, while there is no further change as the frequency goes up to even 10,000 cycles per second. Even though the theoretical expression for the dynamic modulus does not contain a dispersion term, it is however well known that in the case of metals there is a definite rise in elasticity as the frequency rises from a low mechanical vibration to a sonic or ultra-sonic frequency. In studying variation with temperature, Hearmon recommends and has adopted a dynamic method. The very poor thermal conductivity of wood would greatly mitigate against thermal equilibrium being established even in slow oscillations. A good static method with a good thermo-static control of temperature and plenty of time allowed between loading and observation is more likely to yield a correct picture of temperature variation of elasticity. It would have been better if, in deriving equations 19 and 20, terms for the glue layers had been explicitly included. It is interesting to

note that the elasticity of plywood is greater in bending or compression according as the grain of the faceplies is parallel or perpendicular to the length of the specimen. The work on the buckling of plywood plates and tubes is of great practical utility. On the whole, the extension of the author's work to Indian timbers will be of very great practical interest especially at this time when the nation's air sense is rapidly expanding and its forest resources are being systematically investigated.

P. S. S.

A Textbook of Bacteriology. By N. G. Pandalai, M.D., D.T.M., F.R.C.P., Professor of Bacteriology and Principal, Andhra Medical College, Vizagapatam. (Bangalore Printing & Publishing Co., Ltd., Bangalore City), 1948. Price Rs. 18. Pp. i-viii+748.

As there are very few books on medical and allied literature by authors with experience of Indian conditions this book on bacteriology by Dr. Pandalai is a welcome addition to the literature on the subject. Dr. Pandalai has been associated with the teaching of bacteriology at the Andhra Medical College for over 20 years. Very few can claim to have had such unique opportunities to know the requirements of students. In addition, he has had large experience in clinical bacteriology in the college hospital and thus is eminently qualified for being the author of this book.

After giving a description of bacteria in general, the author has given a detailed discourse on the physiology of bacterial cell. It is obvious that this knowledge is essential to have a rational understanding of the behaviour of bacteria. A chapter has been devoted to the mechanism, care and use of the microscope. The sterilisation of bacteria by various agents, physical and chemical, has been fully described. The author has exhaustively discussed the subjects of infection and immunity in the light of recent developments of biochemical investigations. The specific pathogenic bacteria are described in detail, in separate sections. Human rickettsia, filterable viruses and human virus diseases are also included. Although protozoa do not come under bacteriology a chapter on the subject, essentially of pathogenic importance to man such as plasmodium malaria, trypanosome and leishmania, etc., would have been of immense help to students. The subjects of antibiotics and chemotherapy have also received attention. To make the book complete and comprehensive, even for the students of public health, a chapter on

the bacteriology of water and milk has been included. But one might feel disappointed that no figures for the bacteriological standard for potable water for India or for other tropical condition have been given, although Madras has enjoyed a reputation for pioneer work in this field and a large volume of information on the subject is available. Incorporation of such local information should enhance the usefulness of a book of this kind. One glaring defect to which the author has made apologetic reference in the preface is the absence of proper illustration, the importance of which in a textbook of this kind is obvious. It is hoped that an early revision will rectify all these defects. On the whole the book is a worthy contribution to the medical literature of Indian authorship and is commended to the students and members of the profession.

On the publisher's side, there is room for improvement in the quality of the paper and printing.

K. P. MENON.

Survey of India Technical Report 1947—Part III Geodetic Work. (Compiled at the Survey Research Institute and Printed at the office of the Geodetic Branch Survey of India, Dehra Dun, 1948, Price Rs. 4).

Geodetic work in India had been going on at a very low ebb since 1931 owing to financial stringency, and was almost at a stand still for some time after the beginning of World War II. However, owing to the necessity for solving geodetic problems connected with the War effort, a Survey Research Institute was organised in 1943, and this Institute is being continued as a permanent organization since December 1946. A good deal of useful work has been carried out by the Institute in 1947.

The report under review presents in seven chapters a comprehensive account of all the information which had accumulated from 1939 to 1947. The data concerning a continuous chain of Triangulation from Syria to Malaya have been presented. The possibilities of connecting the Triangulation through Sumatra and Java to Australia and Philippines in the East, have been pointed out. The data concerning the Persian Triangulation connecting the Indian Primary and the Iraq Primary systems have been presented, and the problems of Indo-European connection have been discussed. The discrepancies at junctions of various countries are pointed out. The maps of each country are gridded with respect to its own

sphericals, and when boundaries are crossed, the maps may be out of sympathy with those of the adjoining country. The adoption of a suitable spheroid like the International, in India, is said to involve republishing all our trigonometric data and a shift of the details which means a colossal and expensive undertaking. It is suggested in the Report that the two differing series of maps may have a certain area of overlap, amounting to one sheet depth, on either side of the junction line, and that the two sets of maps should indicate the discrepancies by suitable marginal notes.

High Precision Levelling data in India are presented in Chapter II. The succeeding Chapter on the measurement of Gravity, furnishes a brief description of the Frost Gravimeter which is now being used by the Survey of India. The results of the trial observations taken with this instrument near Dehra Dun are recorded. The future programme of providing a close 10 mile net work of gravity stations using this instrument, is outlined. The existing 70-mile grid has been based on pendulum observations which are far inferior in sensitivity when compared to those obtainable with the modern Gravimeters. The proposed Gravimeter Surveys on a close net work of stations may be expected to yield many interesting details of the nature of the earth's crust in this part of the World. Moreover, these stations will serve as bench marks for detailed local geophysical prospecting in the exploration for minerals and oil in certain parts of the country. Magnetic Variometer measurements are also proposed to be combined with the Gravimeter measurements on this close net work of stations--thus adding to the value of these geophysical observations for geologic interpretations. The Report mentions that such gravimeter and magnetic surveys are already in progress in the Raniganj coal field area in Bengal and near Nagpur in C.P. The results of these measurements which are promised to be published in the next Technical Report will be watched with great interest particularly by geophysicists, geologists and those connected with the mining industry.

The data obtained on the Deviations of the Vertical have been discussed in Chapter IV. In particular, the Charts of the Geoid in India and neighbouring countries have brought together all the data collected upto 1947. One of the inte-

resting features observed deserve to be mentioned here: while the geoid in Peninsular India displays humps of the order of 30 feet above the International Spheroid, its rise in Burma is 110 feet, in a distance of only 1,000 miles,—which is regarded as phenomenal and without parallel anywhere else in the world.

The observed deflections in the plumbline in India are usually said to be independent of the major visible features, indicating that there are equally important hidden features at work. The plumb line deviations connected with the Himalayan Range are well known. From the results obtained recently in the Kulu valley, it is stated that the geoid rises from south to north in that region, and also that evidence is accumulating that the geoid in the main goes with topography. So the opinions expressed previously to the effect that the geoid would be found to be depressed under the Himalayas, because the mountain range is constituted of sedimentary rocks, appear to be incorrect. Such measurements however, ought to be extended over a larger area and in a closer net work of stations, before these inferences can command a general acceptance.

The work carried out by the computing office at Dehra Dun is outlined in Chapter V. An account of the Tidal observations and inspection of the Tidal observatories, is given in Chapter VI. The results of the routine, and research work carried out in the Observatories of the Survey of India are presented in Chapter VII. The causes which led to the closing down of the Magnetic Observatory at Dehra Dun in August 1943 and the attempts that are now being made to start a new station are also given. Finally, the results of the magnetic field work carried out between 1942 and 1947 are presented. Most of these observations were carried out to meet the demand for accurate data on magnetic declinations for maps for military purposes. For lack of proper Observatory control, much of the data then obtained could not be corrected for diurnal variations and perturbations. A magnetic variation chart for Epoch 1946 is also reported to have been compiled.

Mr. B. L. Gulatee, President of the Survey Research Institute, is to be congratulated for promptly re-starting the publication of the Geodetic Reports which had been suspended since 1940.

M. B. R. RAO.

GHEE—ITS PRODUCTION AND MARKETING

THE most striking difference in the dairy industry of this country and that in the West is that a large bulk of liquid milk is consumed in the form of its products. The most important amongst these products is ghee for which nearly 43.4 per cent. of the total available supply of milk, amounting to nearly 4929.2 million gallons is used. This position is due to the fact that the production of milk and ghee are followed largely as a subsidiary occupation as a result of animals which every agriculturist must keep for the tillage of land. Further, amongst the products of milk butter-fat is fairly easy to isolate and under normal conditions possesses good keeping quality. Any improvement in the method of manufacture and marketing of such an important product can therefore be expected to be of considerable benefit to the producers. With this object the Central Agricultural Marketing Department* has carried out a comprehensive survey of the methods of manufacture, quantity available, price, methods of assembling, storage, transport and distribution, quality control, and legal standards for ghee in India. Those acquainted with the ghee trade will realise that such a survey is beset with many difficulties, and the results can at best be taken to represent the broad outline of the general trend and not literal facts. This is borne out by a study of the figures for utilisation of milk given in the present survey carried out in 1945 and those reported before.† Whereas previously it was stated that 27.3 per cent. of total milk produced is utilised for fluid consumption, 58.0 per cent. for making ghee, and 14.7 per cent. for making other products, the latest publication gives these figures as 35.4, 43.4 and 21.2 per cent., respectively.

The production of ghee is concentrated mainly in the northern and western regions, which account for three-fifths of the total ghee produced. Madras, Mysore and other South Indian States contribute only to the extent of about 13 per cent. of the total Indian production. An idea of the difficulty in marketing this almost an universal item of diet in the

country will be had from the fact that the amount of ghee produced per annum per 100 persons varies from 0.4 maunds in Assam to 16.0 maunds in Rajputana, which when worked out on the basis of production per square mile comes to 0.8 maund in Assam and 28.5 maunds in Baroda State, the average for the whole country coming to only 8.9 maunds per square mile. The average *per capita* consumption for the country as a whole comes to a very meagre figure of 2.8 lb. per annum. Only a small portion of the ghee produced is retained by the producers, and the marketable surplus varies from about 20 per cent. in the Punjab to 97 per cent. in Hyderabad. It is also noticed that in places which produce less ghee, the producers tend to dispose off a greater part of their production. As a rule the consumption of ghee in urban areas is much higher than the corresponding rural areas, the only exception being the Punjab where these two figures are almost equal. In Bihar the difference is most marked, the *per capita* consumption in rural areas being 0.6 lb., whereas the corresponding figure for the urban areas is 20 lb. per annum.

Though the basic method for the isolation of ghee is largely the same, namely by churning soured milk and melting the butter, the quality produced shows wide variation. Thus there seems to be much scope for improving the quality of ghee by suitable propaganda. Knowledge about the preparation of good ghee is now available. The process is very simple, the essential things being observance of cleanliness at every stage of preparation, and control of the final temperature of melting butter to obtain ghee with pleasant aroma and good keeping quality. It is possible to obtain good ghee either by the *Deshi* process, or from creamery butter, or by directly heating cream. *Deshi* method tends to give ghee with a more appealing appearance and aroma for reasons not yet fully understood. Though a low yield of butter-fat is obtained by this method it is due more to the unfavourable conditions of churning generally adopted rather than due to any inherent defect in the method. Under ideal conditions a loss of only 7 to 8 per cent. of butterfat occurs, and this loss is not a loss in the trade sense as buttermilk is normally consumed by the producer. Any hasty replacement under village conditions of this traditional method with a view to secure a few more percentage of ghee will result in the loss of a valuable by-product, namely separated milk, which cannot

* "Report on the Marketing of Ghee and Other Milk Products in India," Central Agricultural Marketing Department, Govt. of India, 1948, Manager of Publications, Delhi.

† "Report on the Marketing of Milk in India and Burma," Central Agricultural Marketing Dept., p. 67, 1943.

be readily utilised in the same manner as buttermilk.

As things stand to-day a large quantity of inferior quality ghee is put on the market, the two main defects being high amount of free fatty acids and off flavour. The general trade practice is to blend the inferior product with good quality ghee which ultimately results in the lowering of the general quality. In the present legal set of standards prescribed adequate consideration is not given to define quality more scientifically. Bazaar ghee has an established reputation for adulteration and any individual trader trying to sell pure ghee is likely to meet with disappointment in the beginning. This state of affairs could be remedied only by a determined effort by the trade itself. The quantity of ghee produced in the country is very inadequate to meet the nutritional requirements of the population and with the present high price of ghee, only the upper strata of the society can afford to patronise it. It is essential for the trade to grasp this simple fact and give up the vain attempt to compete with cheaper fats. Propaganda on scientific lines is lacking in the country and without any positive proof it is believed by many that ghee is superior to other cheaper vegetable fats and essential in their diet though little is available. A large amount of scientific literature is available on the nutritive value of fats in general and it is rather surprising why our scientists feel so shy to speak out the truth. The report reviewing the extent of adulteration mentions that "in Bombay city alone there are about 40 establishments engaged in the scientific blending of vegetable oil products and genuine ghee". Though adulteration of ghee is widespread this is no doubt an astounding statement especially as it comes from a Government department. It is doubtful if adulteration can be said to be carried out so openly in a big urban centre without attracting the attention of the authorities concerned. A few such hasty statements are noticeable in the report which could have been put in a better way by careful revision.

The report contains at certain places unnecessary details about the method of manufacture which seem entirely out of place in a report on marketing. The same applies to some of the illustrations. Unnecessary paraphrasing, as illustrated by the following comments, could have been avoided:—"The outturn of *rabri* is estimated at 25 to 30 per cent. of milk. Thus 10 seers of milk yield nearly two and a half to three seers of the product" (page 63). The report on the whole makes only a passing reference to the cost of production of

various products, a subject on which a survey of this type could be expected to throw considerable light.

The methods commonly followed for handling ghee at the collecting and blending centres leave much to be desired. The whole process is carried out in a crude manner. In fact, it is a wonder that inspite of such rough handling the product retains its marketable quality. The ghee that comes to the market is sold in a rather crude manner. For this reason ghee trade has to meet a keen competition from the *vanaspati* industry. On account of the doubtful quality of market ghee, *vanaspati* finds many adherents without much coaxing. For this state of affairs the ghee trade alone is to be blamed, as such a big industry has made no serious attempt to organise and utilise available scientific knowledge that will win the confidence of the consumers.

It is not always easy to define quality quantitatively as ghee varies in composition due to various factors, the most important of which is food. Much of the confusion in quality control is no doubt due to these natural variations. It is, however possible to produce a very nearly uniform product by a judicious adjustment of feed. The present multiple standards prescribed for quality leave much to be desired, and as every analyst is aware serve only to create more complications. A uniform standard for the country as a whole is not only desirable but will greatly simplify the matter, and should not prove difficult to evolve if the subject is approached logically. For this purpose it is suggested that specifications for quality control work should include only the usual organoleptic tests, a limit for free fatty acids content, a minimum Reichert value of 24 to 26 (or better corresponding refractive index reading so that much time will be saved in analysis), a negative phytosteryl acetate test, and a minimum value for vitamin A content. Sometimes ghee has the required Reichert value but it is offensive to taste. An insistence on a minimum vitamin A standard will help to safeguard the quality to a great extent. Further, nutritionally there is nothing much to choose between ghee of high or low Reichert value, or between ghee and other cheaper fats, except that ghee is rich in vitamin A. Hence it is logical that there should be a minimum standard for vitamin A content. Even if a low Reichert value of 24 is allowed in order to secure an uniform all-India standard, the genuineness of ghee will be safeguarded by inclusion of the phytosteryl acetate as a routine method. If ghee falls below a certain minimum value for vitamin A it should not be allowed to be sold as ghee.

SCIENCE NOTES AND NEWS

National Institute of Sciences of India

At the meeting of the Council of the National Institute of Sciences of India held at Bangalore on the 6th May, 1949 the following awards of Research Fellowships were made:—

National Institute of Sciences Senior Research Fellowship:

1. U. R. Burman, M.Sc. (Cal.), to work on "Internal Constitution of Stars" at the University of Calcutta.
2. Dr. A. B. Kar, Ph.D. (Edin.), to work on "Endocrinology with special reference to Birds" at the Central Drugs Laboratory, Calcutta.
3. Dr. S. M. Mukherji, D.Sc. (Cal.), Ph.D. (Bir.), to work on "Use of metal-ammonia reduction method in the syntheses of naturally occurring substances and valuable intermediates" at the University of Calcutta.
4. Dr. K. V. Srinath, Ph.D. (Lond.), to work on "Cytology" at the Central College, Bangalore.

National Institute of Sciences Junior Research Fellowship:

1. Miss Ira Bose, M.Sc. (Cal.), to work on "Effect of Ionising Radiations on Grasshopper chromosomes" at the University of Calcutta.
2. Mr. S. Datta Majumdar, M.Sc. (Cal.), to work on "Relativity and Quantum Mechanics" at the University of Calcutta.
3. Dr. S. G. Joshi, Ph.D. (Bom.), to work on "Mineral Nutrition of Plants and Microbial and Biochemical activities in the Soil" at the Fergusson College, Poona.
4. Mr. T. M. Mahadevan, M.A. (Mad.), to work on "Rare Minerals of Madras Presidency—a study" at the Presidency College, Madras.
5. Mr. D. K. Mukherji, M.Sc. (Cal.), Dip. Agri. (Cantab.), to work on "Plant Physiology as applied to Plant Breeding (Embryoculture)" at the Indian Agricultural Research Institute, New Delhi.
6. Mr. K. Subramanyam, M.Sc. (Mysore), to work on "Embryology and Floral Anatomy in some members of Melastomaceæ and Embryology of Lobeliaceæ, Campanulaceæ and Stylidiaceæ with a note on the interrelationship of these families" at the Central College, Bangalore.
7. Mr. B. V. Sukhatame, M.A. (Delhi), to

work on the "Theory of certain distribution in Non-parametric tests and its applications" at the Indian Council of Agricultural Research, New Delhi.

Imperial Chemical Industries (India) Research Fellowship:

1. Mr. A. K. Chakravarti, M.Sc. (Cal.), to work on "Cytogenetics on some common fruit trees of India and the application of colchicine to raise improved types" at the University of Calcutta.
2. Dr. A. P. Mahadevan, M.A. (Mad.), B.Sc. Tech. (Bom.), Ph.D. (Lond.), to work on "Studies in the Pterin Field" at the University of Madras.
3. Mr. C. Ramasastry, M.Sc. (Mad.), to work on "Spectroscopy" at the Andhra University.
4. Dr. K. K. Reddi, Ph.D. (Mad.), to work on "Role of anti-thiamine factor in Nutrition" at the Indian Institute of Science, Bangalore.

Zoological Society of India

The annual meeting of the Calcutta Branch of the Zoological Society of India was held in the Indian Museum on 20th April 1949.

Condolence resolution was passed on the death of distinguished scientists like Prof. Ram Unni Menon, Prof. Birbal Sahni and Dr. Immes. The Secretary then read the annual report of the branch. New Office-bearers were elected for 1949 as follows:—

Chairman.—Dr. Satya Charan Law, Ph.D.
Secretary.—Mr. Satyendra Prasanna Basu M.Sc., re-elected. Dr. S. P. Ray Chaudhuri of the Zoology Department, Calcutta University, gave a lecture on "Cytology and Systematics".

Dr. Lal C. Verman

Dr. Lal C. Verman, Director, Indian Standards Institution, will be leaving for Paris next month, to attend a conference of the International Organization for Standardization, as the representative of India.

ERRATA

Vol. XVIII, No. 4, April 1949, page 132.
Note on Bond Energy and Ionic Character of Hydrogen and alkali Halides: for

$$\Delta i = D(A-B) = (1-i) \sqrt{D(A-A) \cdot D(B-B)}$$

read

$$\Delta i = D(A-B) - (1-i) \sqrt{D(A-A) \cdot D(B-B)}$$

Vol. XVIII, No. 3, March 1949, page 76.
Note on Dielectric Constant of ionic solids: In equation 1 for u^2 read μ^2 .

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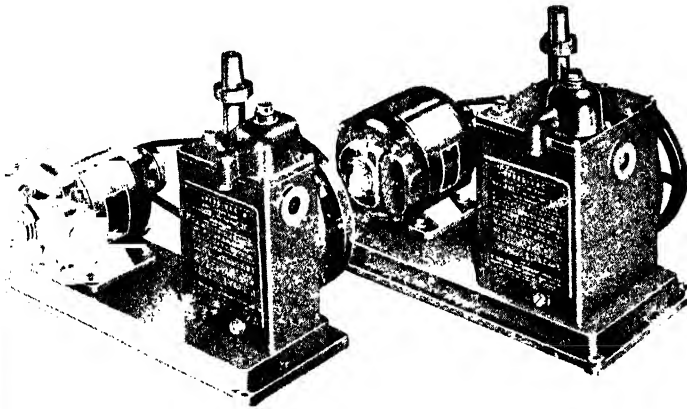
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Current Science

Vol. XVIII]

JUNE 1949

[No. 6

	PAGE		PAGE
<i>The Egerton Committee Report</i> ..	191	<i>Obituary -Professor Birbal Sahni, F.R.S.</i>	
<i>The Adventure of Education..</i> ..	194	L. RAMA RAO	199
<i>An Investigation into the Heat-Treatment of Silico-Manganese Spring Steels—</i>		<i>Letters to the Editor</i>	202
B. R. NIJHAWAN	195	<i>Reviews</i>	219
<i>Grant for Cancer Research</i>	198	<i>Science Notes and News</i>	226

THE EGERTON COMMITTEE REPORT

THE long and the eagerly awaited press summary of the report of the Egerton Committee on the working of the Indian Institute of Science, has appeared in the Daily Press and according to the same source, the full report is scheduled to come up for discussion before the Governing Council of the Institute at its meeting to be held during the first week of July. The Egerton Committee is the fourth of its kind which has periodically reviewed the work of the Institute and made recommendations on its future development. According to reports appearing in the press, the report consists of 68 pages of printed matter and is divided into four sections: (1) General considerations and character of the Institute, (2) Organisation and Administration, (3) Review of the work of the Institute and (4) Financial review.

The Committee considers that the character of the Institute has changed considerably during its life of some forty years and concluded that the Institute has, as it exists to-day, much in common with sister establishments like the Imperial College of Science, London, and the Massachusetts Institute of Technology, Boston. The Committee is of the opinion that having regard to the broad intentions of the illustrious Founder and the prospective needs of the country during the next 20 years, the Institute should develop along the lines of a higher technological institute, its functions being mainly post-graduate teaching and research. The Committee has gathered the impression that the development of the Institute has not been entirely satisfactory and that it has not attained the status it might have done. The

lack of a clear, well defined and uniformly sustained directive has been considered to be responsible for the vascillating, timid and hesitant character of the policy which has distinguished the administration of the Institute in the past. It will be recalled that the preceding Reviewing Committees also have made in their reports a similar remark. In 1921 the Pope Committee recorded "it cannot be denied that the Institute has lost in efficiency by reason of the fact that its policy and lines of development have never been defined with sufficient precision". The Sewell Committee in 1930 also deplored the lack of a definite policy and expressed the opinion that "a suitable balance of pure and applied research had not been established and that greater emphasis should be laid on fostering contacts between the Institute and the industries in India". The Irwin Committee which had the misfortune of conducting the enquiry in the then prevailing tempestuous atmosphere of prejudice and passion, "felt compelled to consider the whole question of the aims and objects of the Institute" and expressed the view that the "province and purpose of the Institute must be defined in more precise terms than at present" and pleaded that "such a definition should be adopted officially both by the Council of the Institute and by the Government of India". It is regrettable that the Egerton Committee, the fourth in succession, should still have been obliged to record the lack of a well-defined objective in the development of the Institute.

The Egerton Committee has taken note of the fact that the Institute has greatly expanded in recent years, both in scope and size, and that several new departments of national importance have been inaugurated. These far-reaching developments are due to the vision and statesmanship of Sir J. C. Ghosh who, in the best interests of the smooth, efficient and ordered execution of these expansion plans, should never have been disturbed from his position as Director.

Before further stages of expansion are initiated, it is felt, that the present expansion should be satisfactorily completed and fully consolidated. The expansion schemes should take into consideration the lines of development of the National and other laboratories and avoid wasteful duplication of scientific effort. It is generally felt that the administration of the Institute has not bestowed adequate thought to this aspect in its scheme of expansion; it is not difficult to point out duplications in the lines of development. In this connection it is pertinent to quote the Sewell Committee which has declared that "whatever developments take place in the universities, we are convinced that with the resources at its disposal, this Institute ought always to be in a position to supply such opportunities for training as cannot be obtained anywhere else in India. *This Institute should do what no other institution can do. It should maintain a position of pre-eminence; it should acquire a national, even a world reputation; it should become a place of reference*".

The Committee have generously admitted that the Institute has an established position and has, in the past, constituted a centre of research where much has been accomplished and valuable personnel trained. The happy circumstance that some of the most responsible positions in the scientific departments and industrial concerns are held by the alumni of the Institute bears eloquent testimony to this proud fact. The late Sir Martin Forster who was during his directorship associated with a brilliant team of departmental heads—Drs. Simonsen, Norris and Catterson-Smith, has been largely responsible for this solid contribution.

A criticism which may be legitimately offered in connection with the development of the Institute relates to the question as to why the Institute has not established itself as an international centre of research. Forty years is a sufficiently long

period for an institute to achieve this distinction. To-day some may even challenge the pre-eminent position which the Institute is expected to occupy in the scientific and technological life of the country. The Egerton Committee provide an answer to this when they state that the status and development of an institute "like that of all organisations will depend largely upon the calibre of the men in the higher posts". The Committee have attached the greatest importance to the question of choosing proper *Men*, the most vital of the four Ms enunciated by Professor A. V. Hill.

Sir C. V. Raman, soon after he assumed charge of the Directorship of the Institute in 1932, found the Institute wanting in the right type of men and made a vigorous attempt to staff the Institute with men of international eminence. His world-wide fame and his universally recognised eminence and prestige constituted great assets in attracting the topmost men of science to occupy some of the positions which fell vacant during his distinguished directorship. Professor George Hevesy, for example, who later received the Nobel Prize, was to have occupied the Chair of Physical and Inorganic Chemistry if events had moved in a direction fortunate to the Institute. Unfortunately for the Institute, a great opportunity was lost; the prospect of a glorious future envisaged at that time was, shall we say, postponed for another two decades. It is interesting to reflect that Sir C. V. Raman, some 17 years ago, had already anticipated the recommendations of the Egerton Committee, particularly with respect to the expansions, *e.g.*, the Chair of Mathematical Physics and the Department of Instrumentation.

The Egerton Committee appear to have emphasised the imperative need of a scientific man of eminence "with a keen appreciation of research and a capacity for leading men", for presiding over the affairs of the Institute as the Director;

they add that the Director should be invested with full powers for administration. The Pope Committee considered that the Principal (Director) "should be a scientific man of eminence and of proved administrative capacity; no person, however capable he may be, can preside with intelligence and sympathy over the operations of the Indian Institute of Science if he is not himself steeped in scientific modes of thought and scientific aspirations". It may be useful to record here the views of President Vannevar Bush of the Carnegie Institution of Washington who has declared: "The Directors of Departments and Chairmen of Divisions in the Institution occupy posts demanding a rare combination of abilities. The position of the director is marked even more strongly by that duality which I have noted in the functioning of the Trustees. The director can and should be both an investigator and an administrator. As an investigator he joins with his colleagues on a plane of equality in planning a scientific program in which all participate and in which he has his unique part. As the director he administers the program, resolves differences of view, and maintains contact with the President and Trustees. To meet this dual responsibility, he must be a scientific worker of proved ability, and he must possess the qualities of leadership, inspiration, and firmness that evoke the best efforts of colleagues and keep operations moving in the agreed direction. He must likewise have the ability at understanding and guidance for which younger members of the staff will look to him. Thus as an investigator he shares the duty of all scientific men toward rigor, vision, and collaboration. As an administrator, he faces the same duties and needs the same capabilities as does the head of a department in an academic institution and, to some extent, as does the director of research in an independent laboratory."

If men of eminence cannot be found in

India, we should not hesitate to invite others irrespective of nationality. The Sewell Committee records that "in more cases than one, the reputation of a university has been built up round the work of some pre-eminent men. Students are attracted by the reputation of the man under whom they hope to work, rather than by any particular virtue of the university itself. A Nernst or a Ramsay (or a Raman) would draw men to any Institution to which he happened to be attached. We are of the opinion that the Chairs in the Institute should be filled by men of the highest eminence irrespective of nationality and we recommend therefore that the terms of appointment to the Directorate and

Professoriate be made sufficiently favourable to attract such men." The Egerton Committee holds the same view and has accordingly recommended "a revision of salary scales so as to attract and retain men of the highest level".

We hope and trust that the Governing Council of the Institute will take early action on these recommendations and maintain the exclusive and pre-eminent character of the Institute, a position to which it is entitled not only because of its pioneering and brilliant services in the past but also because of the potential prospect of an even greater and glorious future which belongs to it.

THE ADVENTURE OF EDUCATION*

THIS admirably printed and edited Journal is published under the auspices of the Office of the Educational Adviser to the Government of Bombay. Annual Subscription payable in advance is Rs. 8 only; and single copy Rs. 1-8-0 only.

To quote from the Editorial, the ambition of the Editorial Board is "to make the Magazine reflect truthfully (and if possible in a refreshing manner) the trends of educational thought and practice both inside and outside the Province, and we, therefore, invite all those who have anything significant and sincere to say about education, to make use of the Journal". Thus at a time when the country is feeling the effects of newly earned freedom and is planning for an all round development, a journal of this kind devoted to the cause of education and the spread of educational thought is, indeed, quite welcome.

The Journal aims not only at presenting outstanding educational problems in a clear way but also at giving special attention to new educational developments both in India and abroad in the hope that their study will stimulate freshness of approach on the part of teachers. The object is to provoke educational thought and lead to adventurous activity.

In addition to the Editorial, the Journal has the following features:— Educational problems, Education forges ahead, the Educational Digest, the Educational World, the World of Books and the Teachers' Forum. There are a number of interesting articles in this issue of the Journal and a note on "Our Contributors". We wish the Journal useful service and a bright career.

* "The Adventure of Education," Vol. I, No. 1, Jan. 1949, pages 124, a bi-monthly by Mr. K. G. Saidain with an influential Editorial Board.

AN INVESTIGATION INTO THE HEAT-TREATMENT OF SILICO-MANGANESE SPRING STEELS

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A GENERAL impression prevails in the metallurgical field that low carbon silico-manganese spring steels are abnormally sensitive to heat-treatment and are difficult to harden completely. There is a considerable difference of opinion as to the correct treatment of low carbon silico-manganese steel. Colbeck and Hanson¹ have established that temperatures required for complete hardening of these steels are very much higher than the corresponding hardening temperatures for plain carbon steels with the same carbon contents. In one steel containing carbon 0.39%, silicon 1.98%, sulphur 0.027%, phosphorus 0.041% and manganese 0.885%, they put forward a temperature of 1110°C. for complete hardening. In another case with carbon 0.50%, silicon 1.5%, sulphur 0.039%, phosphorus 0.039% and manganese 0.865%—a temperature of 900°C. was claimed to secure complete hardening. Andrew² pointed out the theoretical aspects of the problem inasmuch as the high silicon contents of the steels gradually lifted up the A_1 critical points and lowered the A_3 critical points until in a 2% silicon iron, the A_3 point was completely absent. These have also been the observations of Baker³ and of Hadfield and Osmond⁴.

With, of course, increasing amounts of carbon in the silicon steels, the percentage of silicon required to cause the disappearance of A_3 point or in brief to close the $\alpha + \gamma$ loop would be higher. In practice with low carbon silicon steels, A_1 point gets uplifted so that higher heat-treating temperatures would be needed to form homogeneous Austenite which would on quenching yield the requisite hardened martensitic structures.

Andrew and Richardson⁵ have shown that silico-manganese spring steels require a higher temperature in comparison to chrome-vanadium or plain carbon spring steels for hardening and further that the former are the most susceptible to decarburisation during heat-treatment and to mass effect. Burns⁶ also observed that silico-manganese steels require a high hardening

temperature to develop their best mechanical properties. Charpy & Cornu^{7,8} and Vigoroux⁹ also observed the elimination of A_1 and A_3 critical points in silicon steels. Guillet¹⁰ has recommended a hardening temperature of 850°C. for steels containing 0.35 — 0.45% carbon, 2% silicon and about 1% manganese.

EXPERIMENTAL PROCEDURE

The object of the present investigation undertaken by the author was to further explore the hardening characteristics of various compositions of Indian silico-manganese spring steels. The steels were rolled into flat bars of different sections and cambered into a spring leaf as used in railway locomotives, carriages and wagons. These flat bars were then subjected to different heat-treatments. Individual heat-treated spring leaf was then subjected to a "Scragging" test. This consisted of putting the cambered, heat-treated spring leaf bar under a powerful steam hammer. At dead centre of the standard length of the bars camber AB (Fig. 1) was measured. The hammer was then made to press the cambered

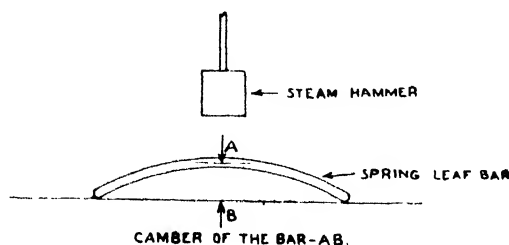


FIG. 1.

spring bar totally flat. It was then released. The camber AB was again measured. If the permanent set after the first blow exceeded $5/16$ ", the bar was considered to have failed in the test. Again the hammer pressed the spring bar flat six times in succession. The camber AB (Fig. 1) was again finally measured. The bar should not show any more permanent set beyond what it had obtained after the first hammer blow if it were to pass the "Scragging" test.

TABLE
Results of Tests on Silico-

Batch and Sample No.	Type Carbon (C) and Silicon (Si)	Section All bars were of the same fixed length (Width \times thickness)	Chemical Analysis			Heat Treatment				Scrapping Tests		
			C %	Mn %	Si %	Quenched in	Quenched from (temperature)	Soaked for	Tempered at (temperature)	Initial reading	After first blow	Set after first blow
Batch A 2	Medium C Si	4 $\frac{1}{2}$ " \times 7/16"	0.55	1.00	1.88	Oil	950° C.	30 Min.	350° C.	3.5/16"	2.15/16"	3/8"
" " 6	do	do	do	do	do	Water	do	do	do	do	3.3/16"	1/8"
" " 10	do	do	do	do	do	do	900° C.	do	do	do	3.3/4"	1/16"
" " 9	do	do	do	do	do	do	850° C.	do	do	3.13/16"	3.11/16"	1/8"
" " 3	do	4" \times 6/16"	0.54	0.96	1.95	Oil	950° C.	do	do	3.7/8"	3.5/16"	9/16"
" " 7	do	do	do	do	do	Water	do	do	do	3.9/16"	3.7/16	1/8"
" " 8	do	do	do	do	do	do	920° C.	do	do	4.1/8"	4"	1/8"
Batch B 12	Low C High Si	3.1/8" \times $\frac{1}{2}$ "	0.47	0.91	1.83	Oil	900° C.	do	do	3"	2.13/16"	3/16"
" " 11	do	do	0.46	do	1.80	Water	850° C.	do	do	3.1/16"	2.15/16"	1/8"
" " 13	do	do	do	do	do	Oil	do	do	325° C.	3.1/4	3.0"	1/4"
" " 20	do	4" \times $\frac{1}{2}$ "	0.50	0.98	2.10	Oil	do	do	350° C.	2.13/16	2.3/4"	1/16"
" " 21	do	do	do	do	do	Water	do	do	do	2.15/16"	2.15/16"	Nil
Batch C 1	Low C Low Si	4" \times 7/16"	0.51	0.93	1.76	Oil	950° C.	30 Min.	350° C.	3.5/8"	2.7/8"	3/4"
" " 5	do	do	do	do	do	do	975° C.	do	do	3.11/16"	3.1/8"	9/16"
" " 4	do	do	do	do	do	Water	950° C.	do	do	3.9/16"	3.3/8"	3/16"
Batch D 16	High C Low Si	4" \times $\frac{1}{2}$ "	0.64	0.90	1.89	do	850° C.	do	do	2.15/16"	2.29/32"	1/32"
" " 17	do	do	do	do	do	do	900° C.	do	do	do	2.15/16"	Nil
" " 18	do	do	do	do	do	Oil	do	do	do	3"	2.13/16"	3/16"
" " 19	do	do	do	do	do	do	850° C.	do	do	2.13/16	2.5/8"	3/16"

I

Manganese Spring Steel Flats

(Reading) AB (Fig. 1)			Hardness Test			Microscopic Examination (Microstructures)
After sixth blow	Set after sixth blow	Performance in scragging test	Surface		Section	
			B.H.N. Centre	B.H.N. Ends	V.P.H.N. On Cross Section	
2-15/16"	Nil	Failed	461	477, 477	564, 570, 550	Tempered Martensite with little feathery ferrite at grain boundaries. Grain size fine to medium. Troostite at boundaries
3-3/16"	Nil	OK, Stood	524	534, 555	635, 618	Uniform tempered martensite with complete absence of free (feathery) ferrite indicating proper quenching
3-1/4"	Nil	do	601	578	644, 626	do
3-11/16"	Nil	do	565	534	640, 618	do
2-5/16"	Nil	Failed	444	444, 429	564, 564	Tempered martensite with free ferrite at grain boundaries. Martensite more tempered than other samples
3-7/16"	Nil	OK, Stood	555	555, 551	593, 618	Uniform tempered martensite with complete absence of free ferrite indicating proper quenching
4"	Nil	do	606	578, 601	635, 626	do
2-13/16"	Nil	do	495	514, 415	543, 511	Tempered martensite with ferrite at grain boundaries
2-15/16"	Nil	do	534	534, 477	601, 593, 582	Uniform fine grained tempered martensite with complete absence of free ferrite at grain boundaries
3"	Nil	Just Passed at 350t. Cit would have failed	477	444, 444	571, 593, 505	Tempered martensite with some free ferrite at grain boundaries
2-3/4"	Nil	OK, Stood	503	495, 471	580, 586	Fine grained tempered martensite with no free ferrite at grain boundaries
2-15/16"	Nil	do	555	555, 538	601, 630	Tempered martensite completely free from any free ferrite separation
2-13/16"	1/16"	Failed	372	363, 365	459, 449	Fine grained tempered martensite with feathery free ferrite at grain boundaries indicating separation during oil quenching
3-1/16"	do	do	444	415, 426	536, 511	Tempered martensite structure with lots of grain boundary ferrite in feathery form indicating separation during oil quenching
3-3/8"	Nil	OK, Stood	514	522, 514	609, 618, 611	Tempered martensite structure with extremely small amount of feathery ferrite at grain boundaries indicating drastic quench
2-29/32"	Nil	do	526	530, 564	606, 593	Tempered martensite structure with no free ferrite
2-15/16"	Nil	do	564	530, 538	571, 571	do
2-13/16"	Nil	do	514	461, 440	550, 557	Fine grained tempered martensite with very small amounts of feathery free ferrite at the grain boundaries
2-5/8"	Nil	do	514	520, 550	557, 571	do

Different sections of each bar were then subjected to a thorough microscopic examination and its micro-structure studied. As would be observed from the details of microscopic examination in Table I those bars which had passed the "Scragging" test exhibited tempered martensitic structures with practically no or a little feathery free Ferrite which had separated during quenching for hardening. Failed bars showed feathery Ferrite formation at the grain-boundaries.

Brinell and Vickers Pyramid Hardness measurements were taken at the ends and centres of the bars on the surface as well as on the cross sections of the bars.

Some typical results obtained during the above tests are recorded in Table I.

From the results of the above experiments it would be observed that fast quenching rates applicable in water-quenching even from 850° invariably gave satisfactory "Scragging" test results whilst oil quenching failed to give satisfactory response in the "Scragging" test in some cases from temperatures as high as 975°C. Water-quenching cannot, however, be recommended for commercial practice owing to the dangers it involves of distortion, warpage, cracking, etc., in particular for high carbon compositions. For low carbon compositions upto 0.40% carbon water-quenching may be safely employed. The above tests were conducted under ideal laboratory conditions of oil bath, regulated heating, one bar singly heat-treated at a time, etc. In commercial practice, the spring bars have to be heat-treated in batches and not singly. Thus although oil-quench from 850°C. have yielded in some cases satisfactory results in the "Scragging" test, in commercial practice higher hardening temperatures of 900°C. or above would be most essential for satisfactory hardening and "Scragging" test performance.

Before, however, finalizing the commercial heat-treating procedure, it would be best to conduct individual laboratory experiments in the first place and to formulate the commercial procedure in the light of the foregoing results obtained. It may also be pointed out here that in comparison with plain-carbon spring steels silico-manganese spring steels require much greater care and attention, e.g. renewal and stirring of oil or water bath, uniformity of heat-treating temperatures and soaking, quick and proper manipulation of the transfer of the steel to the quenching media, etc. Silico-manganese steels are highly sensitive to these heat-treatment abnormalities.

Another factor for which separate research will be necessary, is the effect of "Austenitic grain Size" on the hardenability of silico-manganese spring steel bearing in mind that fine-Austenitic grained Steels are of shallow hardening types and coarse-Austenitic grained of deep hardening types. With an optimum Austenitic grain size much lower oil or water hardening temperatures may be quite feasible eliminating thereby risks of over-heating, decarburization, distortion, warpage, macro- and micro-cracking, etc., accompanying high-temperature heat treatments.

1. Colbeck and Hanson, *J. I. S. I.*, 1924, **109**, No. I, 377. 2. Andrew, *Ibid.*, Discussion on the above paper, p. 395. 3. Baker, *Ibid.*, 1903, No II, p. 312. 4. Hadfield and Osmond, *Ibid.*, 1890, No. I, p. 62. 5. Andrew and Richardson, *Ibid.*, 1935, **131**, No. I, 129. 6. Burns, *Ibid.*, 1932, **125**, No. I, 363. 7. Charpy and Cornau, *Comptes Rendus*, 1913, **25**, 1240. 8. *Ibid.*, 1913, **117**, 319; *Revue de Metallurgie*, June 1915, **12**, 493. 9. Vigoroux, *Comptes Rendus*, 1913, **116**, 1374. 10. Guillet, *J. I. S. I.*, 1906, No. II; *Precisde Metallographie; Les industries Metallurgiques, a l'avant guerre.*

GRANT FOR CANCER RESEARCH

A grant of £1865 (Rs. 24,837) has been made by the British Empire Cancer Campaign to Oxford University to be used for cancer research.

Professor A. D. Gardner, Regius Professor of Medicine at Oxford, in announcing this stated

that during research into chemical substances a new sideline has been found and Sir Robert Robinson, Waynflete Professor of Chemistry at Oxford, had wished to explore this, and for this purpose had applied to the British Empire Cancer Campaign for funds.

OBITUARY

PROFESSOR BIRBAL SAHNI, M.A., D.Sc., Sc.D., F.R.S.

THE news of the sudden death of Professor Birbal Sahni at Lucknow on 10th April 1949, came as an absolute shock to the scientific world; and the loss to India is truly irreparable. It is sad to think that the cruel hand of Death has taken him away from us at the comparatively young age of 58 when he was in the prime of his scientific career, and was looking forward to achieve higher ideals to raise and enhance the prestige and reputation of scientific work in India, and secure for her an honoured place in the international scientific world. The starting of an 'Institute of Palæobotany' in India which would be the first of its kind in the world, and serve as a centre of palæobotanical study and research of the highest order, was Prof. Sahni's life's ambition; during the 30 years of his scientific career, he had kept this objective in view, and dedicated himself entirely to this cause, and was eagerly looking forward to the day when he would be able to realise this ambition. On the 3rd of April 1949 when the Prime Minister of India, Pandit Jawaharlal Nehru, laid the Foundation-Stone of the 'Institute of Palæobotany' at Lucknow, it was indeed a great event in Prof. Sahni's life as the fulfilment of his one great ideal; that he should have been snatched away by Death almost within a week after this event, makes his demise really tragic.

After a brilliant educational career in India, the young Birbal Sahni went abroad for higher studies in Botany, and soon won the highest academic distinctions in his subject in the universities of London and Cambridge. During the latter part of his stay there, he was actively engaged in research and published a number of papers which immediately secured great recognition, and marked him out as one of the outstanding members among the younger botanists of those days. The young Dr. Sahni soon developed a special interest in the study of fossil plants, and naturally joined the famous Cambridge School of Palæobotany under the inspiring leadership of Sir Albert Seward. It did not take very long for the learned professor to discover that in Sahni, he had a most promising and enthusiastic worker who fully deserved his special care and attention; and Sahni soon became one of Steward's 'pet pupils'. Thus was Sahni

initiated into the field of Palæobotany; and what he has achieved as a palæobotanist during these 30 years bears eloquent testimony to the manner in which he fulfilled the highest expectations of his eminent teacher. To Sahni, Seward was at all times his 'revered guru'.

Prof. Sahni will always be remembered for his outstanding work in the field of Palæobotany, and it is no exaggeration to say that the study of Palæobotany in India on modern lines really started with him. During his stay in Cambridge, Sahni had already published several papers on fossil plants; and one of his best known earlier works was his study of the petrified plant remains from the Queensland Mesozoic and Tertiary Formations, published in 1920. This Australian material really came to Prof. Seward for description; but he passed it on to Sahni with the confidence that the young man would be able to deal with it quite efficiently. When the work was completed and Sahni had prepared his paper, Seward passed it on to the Queensland Geological Survey for publication; and in doing so, wrote as follows: "Prof. Sahni devoted himself with his accustomed thoroughness to the work of describing the plants and to the problems that were raised, and after a perusal of the paper he has furnished I must express my appreciation of the able manner in which the investigation was carried out." Another important paper published by Dr. Sahni also in the same year was the one on "The structure and affinities of *Acmopyle Pancheri*" in the *Transactions of the Royal Society*, in which after giving a detailed account of the monotypic New Caledonian genus *Acmopyle*, he discussed with remarkable lucidity some of the most controversial questions like the systematic position of the Taxineæ, the morphology of the ovuliferous scale of Conifers, and the origin of the Conifers themselves. His resolving the Gymnosperms into two divisions—Phyllospperms and Stachyosperms—is recognised as an important contribution in interpreting the evolutionary relationships of this interesting group.

It was also in the year 1920 that a Memoir on "Indian Gondwana Plants: A Revision" was published in the *Palæon-*

tologia Indica Series under the joint authorship of Seward and Sahni; and this may be taken as the starting point for the study of Indian fossil floras on modern lines. After imbibing the best traditions of the Cambridge School, and having worked in such close association with Prof. Seward, Dr. Sahni resolved on his return to India to dedicate himself entirely to the study of Indian fossil plants; and this he did with remarkable devotion and conspicuous ability till the last day of his life.

Starting with this idea nearly 30 years ago, the first thing that Sahni did naturally was to take stock, as it were, of the existing position of Indian Palæobotany, and visualise the possibilities of further work. This he did in 1922 in his Presidential Address to the Botany Section of the Indian Science Congress on "The present position of Indian Palæobotany". In the course of this address he said: "My own interest in palæobotany raises the hope that I may help to bring this fascinating subject more prominently to the notice of my countrymen; and perhaps even succeed in inducing a large number of them to turn their attention to the rich field that it offers for original investigation. With this end in view I propose to devote my address to a brief review of the present position of Indian Palæobotany". The stream of papers on Indian fossil plants by himself and his students which has continuously flowed from Lucknow during these 30 years shows how fully he had succeeded in realising the hopes which he entertained in 1922. It is hardly possible in the course of this short Note to review and give an account of all this output of research by Sahni and his collaborators; suffice it to say that the Lucknow School of Palæobotany under the inspiring leadership of Prof. Sahni gradually came to be recognised as one of the foremost centres of palæobotanical research, and was looked upon in this part of the world with the same regard and recognition as the Cambridge School under Prof. Seward.

The one important point which Prof. Sahni recognised was that all palæobotanical studies must be made in relation to the geological and geographical conditions under which the plants under investigation lived and died; and that without a proper understanding and appreciation of this geological background, the study of

fossil plants loses practically all its vital interest. Thus it happened that Prof. Sahni gradually got more and more interested in geological studies, and he spared no pains in understanding the geological setting of the fossil plant material which he was studying from time to time. This rational line of approach has been most fruitful, and accounts for the very great interest and importance of many of his studies both to the botanist and to the geologist.

A very large amount of work done by Prof. Sahni relates to the study of the Gondwana floras; and in this field, he was an acknowledged authority. Apart from the description and identification of these fossil plants which in itself was a most valuable contribution, he dealt with some of the more fundamental problems connected with the Gondwana floras such as their origin, distribution, evolution, and relationship with the other contemporary floras. Among the more important of such contributions may be mentioned (i) The Southern Fossil Floras, a study in the plant-geography of the past; (ii) Permo-Carboniferous life-provinces, with special reference to India; (iii) Wegener's theory of Continental Drift in the light of palæobotanical evidence; (iv) The relation of the Glossopteris Flora with the Gondwana glaciation; and (v) Recent Advances in Indian Palæobotany. In each of these papers, he has given us a masterly review of the latest position in the light of his own work, and indicated new angles of vision for further studies. His memoir on "*Williamsonia sewardiana* sp. nov. from the Rajmahal Hills," in which he gave an entire reconstruction of one of the first known Indian fossil cycads is recognised as an outstanding contribution from India to our knowledge of this very interesting group of Mesozoic Cycadophyta. Equally important, from the point of view of the vexed problem of the origin of Angiosperms, is his memoir on "*Homoxylon rajmahalense*, gen. et sp. nov. also from the Rajmahal Beds."

From the way in which Prof. Sahni approached the study of fossil plants, it was only natural that many of the results of his work had an important bearing on several geological problems. His work on the flora from the Deccan intertrappean beds of the Nagpur-Chhindwara area and their age indications led to the famous controversy regarding the age of the Deccan

Traps. After about four years of discussion from all points of view, Prof. Sahni's contention, on the evidence of his fossil plants that the Traps are really Eocene and not Upper Cretaceous, has been generally accepted. A most comprehensive and fascinating account of this work was given by Sahni himself in his General Presidential Address to the Indian Science Congress in 1940. His latest work on the discovery of micro-fossils in the salt marl and associated beds of the Punjab Salt Range and their bearing on the 60-year old controversy regarding the age of this 'Saline Series,' is well known; and the Proceedings of the two Symposia on this subject held in 1944 and 1945 in which practically all the leading workers in this field both in India and outside have participated, bear ample evidence to the manner in which Sahni's work has stimulated worldwide interest as offering a conclusive solution to what has been a most intriguing and tantalising problem.

To one who was thus devoting all his time and attention to scientific research and was making several notable advances in our knowledge, it was only natural that the highest honours and distinctions in the scientific world came to be conferred upon him in quick succession from time to time. Prof. Sahni was a Foundation Member of many of the scientific bodies in India, and always played a most effective part in promoting and upholding the highest traditions of scientific research in this country. He frequently went abroad in response to invitations for participating in congresses and conferences concerned with palæobotany; only a few days before his death, he was elected as the President of the International Botanical Congress to be shortly held at Stockholm,—but, alas, he has not lived to occupy that Presidential Chair which, we are sure, he would have done with outstanding ability and distinction, adding to India's glory in the international scientific world.

As a scientist, Prof. Sahni was known for his thoroughness in looking into every detail of the investigation; and whether it was his own work or that of others, he insisted on being satisfied on every point of observation, illustration, or discussion, before he would pass it for publication. What he said of

another eminent palæobotanist is equally true of himself: "Like all cautious workers, he was difficult to convince...but was by no means of the type that clings to pet theories". For clarity of presentation, lucidity of argument, and due consideration for the 'other point of view', Prof. Sahni's papers are a model for others to follow. A great feature of Dr. Sahni's work as a man of science, was that apart from his own personal investigations, he had organised a School of Research at Lucknow where a team of young and enthusiastic students had gathered round him and carried out original work of the highest order under his personal care and attention. Every worker in the field of palæobotany and allied subjects in India looked up to him, at some time or other, for help and guidance. Singularly free from all passions and prejudices, personal or provincial, Prof. Sahni gave of his best to every one of these workers promptly and generously; and all of them recall with regard and affection the many acts of kindness which they have received at his hands.

Apart from the greatness of his accomplishments as a scientist, Dr. Sahni's human qualities of kindness and friendship were really unique. Belonging to a noble and highly cultured family, he possessed a most amiable and charming personality, and endeared himself to one and all alike. To see him, was to like him; to know him, was to love him. Those that had the privilege of enjoying the genial hospitality of the Sahnis at Lucknow know how fondly they were attached to each other, and had built up for themselves a home with an all-pervading atmosphere of peace, happiness, affection, and goodwill.

The late Prof. Sahni has left behind him a glorious record of scientific work; and by his untiring endeavours, he has laid the foundations for the study of Indian palæobotany trulyp and well. The 'Institute of Palæobotany' which will grow up in Lucknow will live for ever as a fitting monument of his achievements and aspirations in the cause of Palæobotany, and serve as a perpetual source of inspiration to workers from all parts of the world in this fruitful and fascinating field of study and research which he so richly adorned.

L. RAMA RAO.

LETTERS TO THE EDITOR

	PAGE		PAGE
Sunspots and Cosmic Ray Intensity— KULDIP CHAND CHADHA	202	A New Leaf-Spot Disease of Castor Ricinus communis L.—S. K. BOSE AND S. C. MATHUR	210
Nuclear Magnetic Resonance and the Effect of the Methods of Observation— G. SURYAN	203	Life-History, Bionomics and Control of Safflower Aphids (Macrosiphum jaceace Lin.)—K. N. TREHAN AND N. L. HALLEAPANAWAR	211
Purity of Milk—L. D. MAHAJAN AND O. C. MATHUR	204	A Comparative Study of the Catalase Activity of the Petals and Leaves of Hibiscus rosasinesis.—SHYAMANANDA PATTANAIK	212
Elastic Constants of Sodium Chlorate and Sodium Bromate—R. V. G. SUNDARA RAO	204	Xanthomonas desmodii, A New Bacterial Leaf-Spot of Desmodium diffusum DC.—M. K. PATEL	213
Production of p-Cymene from Carene—JAMES VERGHESE, H. K. SONDHI, BHARAT BHUSHAN AND M. L. JOSHI	205	Trials of U.S.A. Hybrid Corn (Maize)—B. SEN	213
Potassium Persulphate as Initiators of Polymerization in Solution—RANAJIT SENGUPTA AND SANTI R. PALIT	206	Culturing of Pro-Embryos of Normal Diploid Corn (Maize) Aged 3 to 7 Days—P. UTTAMAN	215
Pyrogenic Decomposition of Carene in the Presence of Copper and Aluminium Catalysts—JAMES VERGHESE, H. K. SONDHI, BHARAT BHUSHAN AND M. L. JOSHI	207	The Life-Cycle of Moniliformis moniliformis (Bremser, 1811), Acanthocephala—(Mrs.) E. SITA	216
On the Nature of Inhibition of Erythrocyte Pyrophosphatase by Veronal-Acetate Buffer—B. NAGANNA	207	A Modified Method for the Esterification of Some Polyhydroxy Aromatic Acids—P. R. SARAIYA AND R. C. SHAH	218
Tricotily in Capsicum annuum Var. Grossa Sendt.—M. S. CHENNAVEERAI AH	208	Sugarcane x Bamboo Hybrids—T. S. VENKATARAMAN	218

SUNSPOTS AND COSMIC RAY
INTENSITY

IN recent decades, Sunspots have been observed to influence C.R.I. (Cosmic Ray Intensity). Finer observations have shown that C.R.I. first increases and then decreases whenever a major Sunspot appears.

Considering the phenomenon to be inexplicable by the existing theories, Alfven¹ has offered a new explanation. He explains C.R.I. variations in terms of changes in Earth's electrostatic potential, which, he assumes, are caused by the approach of an ion-cloud from above a solar-flare. This gets polarised due to the solar magnetic field. The preceding +tive pole induces -tive potential in the Earth, which changes to a +tive one as the tail of the cloud approaches. The initial -tive and the subsequent +tive e.s. potentials of the Earth cause an initial increase and the final decrease in C.R.I., because the Cosmic Rays are more abundantly +tive.

The ion-cloud would take, as Alfven also thinks, about 24 hrs. to travel from a solar-flare to the Earth. Thus, on his hypothesis,

we expect:—(i) an initial increase in C.R.I., about 24 hrs. after the observation of the solar-flare, and (ii) a subsequent decrease, a day or so after this increase.

The observational facts do agree with this sequence of variations. But Alfven's theory shifts the whole phenomenon by about 24 hrs., as the following table (based on ref. 2, 3, 4) reveals.

Occurrence	Observation of Solar-flare	C.R.I. increase	C.R.I. decrease	Commencement of Mag. Storm
February-March 1942	28th Feb. 11 h. 54 m.	28th Feb. 14 h. 30 m.	1st March 6 h. 50 m. (App.)	1st March 7 h. 27 m.
July 1946	25th July 17 h. 30 m.	25th July 18 h. 15 m.	26th July 18 h. 0 m. (App.)	26th July 19 h. 0 m.

It is clear from this, that the ion-cloud which takes about 24 hrs. to travel to Earth, cannot cause the initial increase, which takes place within two-three hrs. of the flare-observation. This increase requires, for its explanation, an agent which possesses

ses a much greater velocity. Will not some part of solar-spectrum answer the call—for example the u.v. rays? These radiations are given out in great abundance from above Sunspots. Hence there is nothing wrong in assuming u.v. rays to be the cause of the C.R.I. increase.

The final decrease may be due to the electron-cloud that will take some time to reach the Earth, and will induce +tive potential in it, which will, therefore, repel the +tive component of Cosmic Rays, and thus cause decrease. The same electron-cloud gives rise to the main Magnetic Storm.

It may be added that the disturbances in the long range radio-wave propagation have been analysed into those occurring almost simultaneously with the observation of the flare and those which follow about a day later. These two phases of a single phenomenon have also been explained in terms of the u.v. rays and the ionic radiations respectively.⁵

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NUCLEAR MAGNETIC RESONANCE AND THE EFFECT OF THE METHODS OF OBSERVATION*

THE successful observation of nuclear paramagnetic absorption and nuclear induction depends primarily upon the fairly short relaxation times for the nuclei. This fact, viz, the short relaxation times being found for nuclei even in the case of crystals and extremely low temperatures is perplexing. According to the theory of Waller^{1,2} regarding the interaction of spin and lattice or spin and spin the time required for the nuclei to come to thermal equilibrium is very large being several hours at the least and running to geological orders of magnitude in other cases ($\approx 10^6$ years). What then is the process by which excited nuclei return to the lower states and what happens to the energy so liberated? Having

examined the problem in the light of the above question we find that the very method of observation so far used can to a large extent account for the extraction of energy from excited nuclei. The methods of observation consist in placing the sample in a tuned resonant circuit. The precessing nuclei can all be considered as small resonant circuits and all being coupled to the external circuit. It can be seen that in such a system there will be transformer action and there will be an induced E.M.F. in the external circuit. This is in effect what is observed in nuclear induction experiments. Due to the induced current in the circuit and the finite Q of the circuit there will be losses in the circuit. So there may be a transfer of energy from the inner circuits to the outer circuits.

Considering the nuclei as precessing nuclei also we find that an induced E.M.F. is set up and a consequent loss in the external circuit.

We can make a few simple calculations here instead of going to lengthy rigorous calculations. We have to find the energy lost in the circuit per sec. and the energy available from the nuclei, and by dividing one by the other we can find the time required for all the nuclei to return to their normal states.

We can calculate that the voltage induced is of the order of 1 m.v.³ and if the Q of the circuit is say 10 then the energy

lost per sec. or power loss is $\frac{V^2}{2\omega LQ}$, where V

is the voltage, ω is the angular frequency, L is the inductance. This comes out to be of the order of ($V = 1$ m.v., $\omega = 2\pi 40 \times 10^3$, $L = 1 \times 10^{-6}$) 2×10^{-10} watts in a typical case. The energy available in a typical sample say of hydrogen is no. of nuclei $\times 2\mu H$ (where μ is the magnetic moment and H is the field) which comes to be the order of $10^{16} \times 2\mu H = 10^{13} \times h\nu = 10^{13} \times 6.10^{-27} \times 40 \times 60^6 = 2 \times 10^{-3}$ ergs. 2×10^{-10} watt sec., 2×10^{-10} joules. Therefore the time required for 2×10^{-10} joules to dissipate at the rate of 2×10^{-10} watts is 1 sec. Thus it is seen that the very existence of the tuned circuit can to a large extent affect the observations. The exact value of the time required depends upon the relationship existing between the individual nuclear spins and their relationship to external fields, crystalline fields, etc. This time will be lengthened to some extent by

the decreasing induced E.M.F. as time goes on and loss of coherence between the nuclei. However it is seen that effects of the methods of observation are very important as regards nuclear-paramagnetic-radio-frequency experiments. Here it is found that this part of the time depends upon the Q of the circuit and so experiments may be devised to test the influence of the Q of the circuit.

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Bangalore,
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PURITY OF MILK

THE surface tension of milk and its dilutions with water and the effect of starch on their surface tension have been studied in order to find out a suitable physical method for determination of purity of milk, as the Lactometer (commonly used at present) hopelessly fails to detect (i) presence of water in the diluted milk when some suitable quantity of starch or similar substance is added to it as an impurity or (ii) skimmed milk when a suitable quantity of water is added to it.

The surface tension was determined by the weighing drop method at a fairly constant temperature. The surface tension of milk varied with its dilutions with water as follows:—

Temp.	% water in milk	Surface tension in dynes/cm.	Remarks
17.5° C.	0	56.3	The bazar milk was used.
"	20	56.7	
"	40	57.4	
"	60	58.4	
"	80	60.7	
"	100	73.4	

The starch and similar other impurity have no effect on their surface tension. A set of observations is given below for reference.

Temp.	% starch in pure milk	Surface tension in dynes/cm.	Remarks
215.5° C.	0	57.3	The new sample of bazar milk used.
"	1	57.3	
"	2	57.4	
"	5	57.4	
"	10 (saturated)	57.5	

Thus the purity of milk can easily be detected by measurement of its surface tension. An instrument (the patent applied) based upon the above results serves well for the purpose of finding purity of milk.

Further work in detail is in progress and shall be published in due course of time.

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ELASTIC CONSTANTS OF SODIUM CHLORATE AND SODIUM BROMATE

THE behaviour of sodium chlorate and sodium bromate is peculiar in many ways. The relatively larger bromate ion indicates according to Bragg's contact law for ionic distances that the elastic constants of the bromate should be lower than those of the chlorate. Nevertheless, the very much higher melting point of the bromate ($381 \pm 6^\circ \text{C.}$) over that of the chlorate (248°C.) indicates larger forces of affinity in the bromate. The elastic data provided by Bridgman (1929) and Mason (1946) show that the elastic constants of the bromate are higher. Because of this peculiar behaviour, it is considered desirable to repeat the measurements on the two substances. The results are given below.

The two substances crystallise in the cubic tetartohedral space group T and are piezo-electric. The necessary sections are cut out from well-grown good crystals of the same and the ultrasonic method described by the author (1948) is used. The values obtained in the investigation along with those of other experimenters wherever available are given in the following table.

No.	Substance	Author	C_{11}	C_{12}	C_{44}	s_{11}	s_{12}	s_{44}	β
1	NaClO ₃	Voigt	6.19	-2.087	1.196	24.6	+12.52	83.6	150.0
		Mason	4.90	1.386	1.17	23.35	-5.15	85.4	39.1
		Bhagavantam & Suryanarayana (1947)	5.09	1.18	1.18	22.9	-5.35	84.7	36.6
		Author	4.92	1.45	1.19	23.5	-5.30	84.1	38.7
		Bridgman	..	..	..	..	..	..	50.4
2	NaBrO ₃	Mason	6.16	2.356	1.54	20.6	-5.7	65.0	27.6
		Author	5.45	1.91	1.50	22.4	-5.8	66.7	32.4
		Bridgman	..	..	..	..	..	..	44.1

The values of the elastic constants C 's are given in units of 10^{11} dynes/cm.²; of the elastic moduli s 's and the compressibility β in units of 10^{-13} cm.²/dyne.

β is calculated from the formula

$$\beta = 3(s_{11} + 2s_{12}).$$

Mason's values of s 's are taken from the tabulated results in the case of NaClO₃; for NaBrO₃ they are read off from his graphs corresponding to the temperature 28° C., since no tabulated results are given in the latter case. While there is good agreement in the results of NaClO₃, there is some discrepancy in those of NaBrO₃. This is partly due to the graphical results since a similar discrepancy is found to come out for NaClO₃ also if the s 's are taken from the graphs for NaClO₃ instead of from the table provided in Mason's paper.

However, the fact of the higher elastic constants of NaBrO₃ is definitely established. While no certain reason can be advanced for the curious behaviour, especially in view of the fact that the X-ray values of the ionic distances in NaBrO₃ are very much less clearly established than in NaClO₃, the higher elastic constants of the former may be attributed to the lesser distance between the Na and Br atoms in NaBrO₃ making the interionic distance in NaBrO₃ less than in NaClO₃. From Zachariasen's (1929) values of the parameters for NaClO₃, we get the distance between Na and Cl as

$$D_{\text{Na-Cl}} = 4.017 \text{ \AA}$$

whereas from the parameters accepted by Wyckoff (1931) for NaBrO₃ we get

$$D_{\text{Na-Br}} = 3.718 \text{ \AA}.$$

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are also due to Miss C. Santhakumari for kindly lending the crystals.

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PRODUCTION OF *p*-CYMENE FROM CARENE

ACCORDING to a French patent,¹ *p*-Cymene is prepared by treating turpentine oil with a sulphate of iron in a tube furnace at 175°-250° C.

We have recently subjected carene (b.p. 163°-168° C./745 mm., d_{15}^{15} : 0.8468, n_D^{20} : 1.4716) from Indian turpentine *Pinus longifolia*, to pyrolysis test at 250° ± 15° C, liquid hour space velocity: 0.14, using partially dehydrated ferrous sulphate (8-10 mesh) catalyst.

The catalyst is prepared by heating FeSO₄ 7 H₂O in the reaction chamber at 250° ± 15° C. for 3 hours. Other experimental details are given in previous communications.^{2,3}

After a single pass of carene over the catalyst, the yield of *p*-Cymene on the basis of two-fold fractionation and terpene fed is 30.7%, containing 25-30% unsaturates.

It is therefore concluded that partially dehydrated ferrous sulphate serves as a catalyst, not very active, for dehydrogenating

carene to *p*-Cymene. Also, it suffers from a great disadvantage as it turns powdery after a single pyrolysis.

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POTASSIUM PERSULPHATE AS INITIATORS OF POLYMERIZATION IN SOLUTION

PERSULPHATES though extensively used as catalysts in emulsion polymerization have seldom been studied as catalysts in solution polymerization owing to the difficulty of getting the persulphate in the dissolved state in the usual organic solvents. We have observed that it is possible to carry out the reaction in diethylene glycol with dissolved persulphate and have studied the polymerization of styrene at 80° C. in this solvent. The results obtained however are quite unexpected and warrants the publication of this preliminary report though the detailed results are to be published later elsewhere.

Some typical results are summarised in the table below :—

TABLE

Concentration of catalyst (per cent. on the weight of monomer)	Speed of initial reaction (per cent. conversion per min.)	Intrinsic viscosity
K ₂ S ₂ O ₈ 0.06 per cent. 0.022	0.45 0.2	0.6—1.2
2.7 per cent. benzoyl peroxide	0.18	0.2—0.4

It will be observed from the data presented that weight per weight potassium persul-

phate is a far stronger catalyst than benzoyl peroxide. In fact, roughly speaking one molecule of the persulphate equals the catalytic power of over one hundred molecules of benzoyl peroxide. This is quite remarkable, which is however made more striking by the fact that this high yield is not obtained at the sacrifice of the molecular weight which is usually the case. It will be observed from the intrinsic viscosity values given that while the values of $[\eta]$ with benzoyl peroxide is about 0.2–0.4, the persulphate polymer is about three times that of the benzoyl peroxide polymer, which calculated in molecular weight according to Staudinger-Mark equation,¹ $[\eta] = kM^a$, where $a = 0.62$ and $k = 3.7 \times 10^{-4}$ for toluene, means that the molecular weight of the former is 5.8 times more than the latter. The average molecular weight of the polystyrene produced from persulphate is about 64,000 which strikes as unusually high for such a dilute solution of monomer (16.7% by volume).

The above results make it imperative that in any attempt to explain the unusually high speed and high molecular weight in emulsion polymerization,² account should be taken of the contribution made by this inherent capacity of potassium persulphate to promote speed and chain length as demonstrated above. We have also observed that the persulphate-catalysed styrene polymerization is fairly strongly inhibited by oxygen of the air, a phenomenon which is commonly encountered in emulsion polymerization.

It seems that the observed high efficiency of the persulphate is not solely due to a higher rate of initiation as this will produce a lowering of average molecular weight but probably due to the fact that among the usual processes of termination of free radicals, (a) $M_n \cdot + M_s \cdot \rightarrow M_{n+s}$, (b) $M_n \cdot \times \text{Cat} \cdot \rightarrow M_n \text{Cat}$ and (c) $\text{Cat} \cdot + \text{Cat} \cdot \rightarrow \text{Cat}_2$ (where $\text{Cat} \cdot$ is the free radical produced by catalyst decomposition), the reaction (b) is more predominant than reaction (a), and in the case of persulphate the speed of reaction (b) is comparatively slow. Another factor of importance which might contribute to the superiority of the persulphate is the fact that the inorganic persulphate is stable enough to successfully stand the onslaught of its own free radical whereas the organic peroxide sustains a

concurrent wastage by such attack as shown by Nozaki and Bartlett.³

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January 4, 1949.

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PYROGENIC DECOMPOSITION OF CARENE IN THE PRESENCE OF COPPER AND ALUMINIUM CATALYSTS

ON passing the vapours of carene (b.p. 163-68° C./745 mm., d_{15}^{15} : 0.8468, n_D^{20} : 1.4716, from Indian turpentine, *P. longifolia*) through copper turnings heated to 400° ± 15° C.¹ in the pyrogenic unit previously described,² at an hourly liquid space velocity: 0.14, the terpene hydrocarbon was decomposed. Among the reaction products were 8.8% gases and 89.2% oil. 20.3% of the pyrolysate distilled between 173-78° C./745 mm. (d_{15}^{15} : 0.8697, n_D^{20} : 1.4775) and contained *p*-cymene.

With aluminium turnings, the gases amounted to 12.3% and oil 83.7%. The yield of the 173-78° C./745 mm. fraction was reduced to 18.5% (d_{15}^{15} : 0.8699, n_D^{20} : 1.4797).

The experiments suggest that a furnace of copper³ or aluminium will have a gentle accelerating effect on the disproportionation of carene to *p*-cymene.

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ON THE NATURE OF INHIBITION OF ERYTHROCYTE PYROPHOSPHATASE BY VERONAL-ACETATE BUFFER

It was previously reported¹ that the erythrocyte pyrophosphatase is greatly inactivated by incubation for ½ hr. with M/35 veronal-acetate buffer alone, prior to the addition of the substrate and the activator; and that the presence of the activator (Mg^{++} ion) protect the enzyme from such inactivation to a certain extent. On further study on the nature of the inactivation it was discovered that both the buffer constituents, viz., veronal and acetate, are themselves responsible for the inactivation to a great extent, the inactivation due to heat (38° C.) being comparatively small (Table).

1 ml. of 1 in 20 hæmolysate (human erythrocytes) was incubated with 3 ml. of the inhibitor of different concentrations for varying periods of time, and then the enzyme activity was determined by adding 1 ml. of 0.1 M $MgCl_2$ and 0.5 ml. of 0.01 M sodium pyrophosphate. Period of hydrolysis—15 mins. pH—7. Temp.—38° C. Percentage of inhibitions were calculated from the orthophosphate content of the trichloroacetic acid filtrates.

TABLE

Enzyme incubated with	Per cent. inhibition produced		
	preliminary incubation period 15 mins.	30 mins.	60 mins.
0.2 M Sodium acetate	60	80	..
0.1 M " "	..	68	87
0.04 M " "	..	33	62
0.04 M Sodium veronal	..	76	88
0.02 M " "	..	42	62
0.01 M " "	..	22	34
Water	4	6	13

It was further observed that the pyrophosphate ion affords better protection of the enzyme than the Mg ion against the inhibition due to the buffer constituents.

A number of substances related to the buffer constituents were studied and varying degrees of inhibition were observed. All the solutions were adjusted to pH 7, and after incubating 1 ml. of the enzyme with 3 ml. of the inhibitor of varying concentrations for different time periods, the

activity was determined in *unbuffered* aqueous medium, the period of hydrolysis being reduced to 15 mins.

Among the narcotics studied, luminal is found to be more inhibitory than veronal. The inhibitor effect of acetate is increased by substituting acid groups like halogen or carboxyl (iodoacetate or malonate), while substitution of the basic amino group (glycine) almost abolished the inhibitor effect of the acetate. Alanine and phenyl-alanine produced no inhibition, but tryptophane, tyrosine and cystine produced inhibition.

Besides the inhibitors already reported viz., (1) formaldehyde, alloxan, iodoacetate, oxalate, malonate, and citrate, the following produced more than 50% (in some cases almost complete) inhibition after incubating the enzyme with decimolar solutions of the inhibitors for 30mins: sodium acetate, sodium monochloracetate, sodium butyrate, sodium lactate, sodium mandalate, sodium phenoxyacetate, sodium pyruvate, sodium maleate, sodium malate, sodium fumarate, sodium succinate, sodium aspartate, sodium tartrate, sodium glutarate, sodium glutamate, acetaldehyde, thiourea, guanidine, and creatine. Higher concentrations are required in the case of the following inhibitors:—acetamide and urethane (M), ethanol, methanol, and urea (2 M), and acetone (3 M).

The pyrophosphatases of optimum pH 7.6 of several animal tissues (liver, kidney, intestinal mucosa, brain, testes, spleen, and muscle of guinea pig) showed identity to the erythrocyte enzyme not only in their property of being inactivated by calcium, fluoride, formaldehyde, and ethanol, but also in being inhibited by $\frac{1}{2}$ hr. incubation with veronal-acetate buffer.

Since the pyrophosphate ion protects the enzyme against the buffer inactivation it may be permissible to surmise that the buffer constituents as well as the substances related to them produce inhibitions by blocking the active centres of the enzyme from reacting with the substrate; the inhibitor effect depending upon a particular molecular structure and the extent of inhibition depending upon the nature of the groups in the molecule. Similar observations were reported in the cases of dehydrogenases² and lipases.^{3,4}

Further work is in progress.

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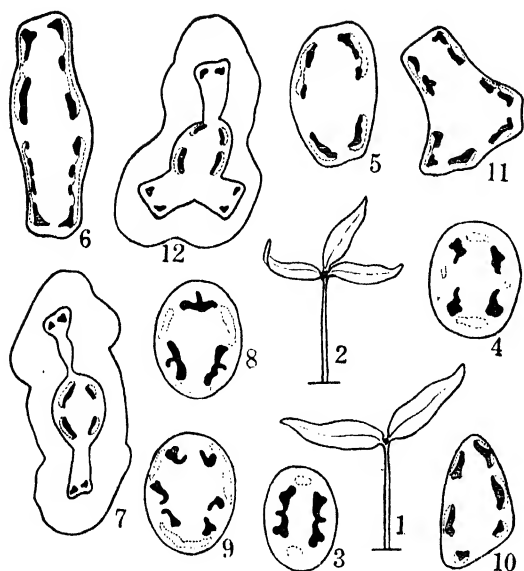
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TRICOTYLY IN *CAPSICUM ANNUUM* VAR. *GROSSA* SENDT.

THE occurrence of two cotyledonary leaves in all dicotyledons is well known though instances are on record where recognisable seed-leaves are wanting or there is only one (Sargent, 1903). In the latter it is assumed that the two cotyledons were completely or partially fused. Compton (1913) has made a detailed study of syncotyly in several dicotyledons. While polycotyly is usual among Gymnosperms (Coulter and Chamberlain, 1910), it is rare in Angiosperms. The following note relates to such a condition noted by the writer recently in *Capsicum annum* var. *grossa*, commonly known as red pepper.

In a culture of seedlings of *Capsicum annum* var. *grossa*, which were raised for cytological work a solitary seedling showed the presence of three cotyledons instead of the normal two. The cotyledons were compared with those of a normally developing specimen of the same age. The cotyledons in the latter (Fig. 1) measured 3.2×0.8 cm. each and the angle of divergence between the point of insertion was 180° . In the tricotyledonary seedling (Fig. 2) one of the three cotyledons measured 2.3×0.6 cm. while the other two were 2.3×0.45 cm each; and the angle of divergence between the larger cotyledon and the other two was much greater than the angle between the larger cotyledon and the other two was much greater than the angle between the latter.

Anatomical observations were made in the tricotyledonary seedling and compared with a normal one. In a normal seedling the root in the early stages is diarch (Fig. 3). A little higher in the hypocotyledonary



(Protoxylem black; Metaxylem cross hatched; xylems of the node, seed leaves and plumule line shaded; Phloem dotted.)

FIG. 1. Dicotylous seedling of 20 days growth. FIG. 2. Tricotylous seedling of 20 days growth. FIGS. 3 to 7. Dicotylous seedling. FIGS. 8 to 12. Tricotylous seedling. FIG. 3. Transverse section of root. FIG. 4. Transverse section of the above at a higher level. FIG. 5. Transverse section below the node of seed leaves. FIG. 6. Transverse section just at the node. FIG. 7. Transverse section at the base of the seed leaves. FIG. 8. Transverse section of root. FIG. 9. Transverse section of the above at a higher level. FIG. 10. Transverse section below the node of seed leaves. FIG. 11. Transverse section just at the node. FIG. 12. Transverse section at the base of seed leaves.

region the two strands divide into four and appear tetrarch (Fig. 4). Very near the cotyledonary node the groups of xylem dilate (Fig. 5) to form a plate (Fig. 6). From the nodal plate two strands are separated on each side to form the vascular strands of each cotyledon and the remaining xylem plate is continued into the plumule as four plumular strands (Fig. 7).

The tricotyledonary seedling on the other hand showed a marked departure in the disposition of its xylem strands. The root at first is triarch (Fig. 8) and each one of these groups divides into two to become hexarch (Fig. 9). Just as in the normal seedling the xylem groups dilate in the vicinity of the node (Fig. 10) and form the characteristic nodal plate (Fig. 11) from which the three cotyledons receive two strands each. The remaining xylem

plate continues to form four plumular strands (Fig. 12) as in the case of normal seedling. The three double bundles to the three cotyledons are the continuation upwards of the three protoxylem groups of the root (Barton-Wright, 1932). It is significant that the points of origin of the double bundles from the nodal plate show marked disparity in their angle of divergence. Two of them are situated 80° apart and the third one is nearly 140° from either of these.

Discussion

Lobed cotyledons with varying degrees of splitting from an apical notch to deep cleavage have been reported by Compton (1913) in the members of *Urticaceae* and *Moraceae*. These have been cited as instances of Schizocotily. The same author mentions that in a specimen of *Cannabis sativa* all the cotyledons were independent. In the plant under report all the three cotyledons are apparently independent and the anatomy of the root clearly shows a triarch structure. Each seed-leaf has its own root pole from which the protoxylem is continued upwards to the cotyledon. One cannot however ignore the difference in size of the cotyledons; one is slightly larger than the other two which are almost equal in size and there is also a significant difference in the divergence of the double strands from the nodal plate. These two features raise the question of the nature of the cotyledons in this case. Naturally the larger cotyledon should be regarded as one independent unit while the two smaller ones may be the result of fission of an originally single member at a very early stage.

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A NEW LEAF-SPOT DISEASE OF CASTOR *RICINUS COMMUNIS* L.

DURING the year 1947-48 a severe leaf-spot disease of Castor (*Ricinus communis* L.) was observed on the Castor crop in the Agricultural College farms at Kanpur. Preliminary microscopic examinations and cultures revealed the presence of a *Phyllosticta*. As no species of this fungus has been known to occur on Castor in India an investigation was conducted.

Symptoms. During the month of July, after the commencement of the rains, minute dot-like light brown spots 0.1–0.3 mm. in diameter appear scattered on the upper surface of the leaf. These spots enlarge into prominent light brown circular lesions usually 0.4 cm. to 1.2 cm. in diameter, but some spots extend upto 2.5 cm. across (Plate I). A few spots are angular in shape. In some cases the spots coalesce



PLATE I.

forming irregular patches. The spots never cross the main veinlets radiating from the apex of the petiole. As the spots enlarge circular zonations of different shades of brown are formed. In many cases the centre becomes white, papery and brittle. Ultimately shot-holes appear in the centre. The spots become dry from the centre outwards. At the margin of the dry area a number of minute white dot-like structures appear in a ring. These gradually turn dirty brown ultimately becoming black and superficial within 48 to 96 hours. As the drying progresses successive concentric rings of such black dot like structures are formed. These are the pycnia of the fungus. As many as five pycnial rings have been observed. The spots attain the

maximum size within 10 to 16 days. The spots are not formed on any other part of the plant.

Mycelium:—The mycelium is mostly intracellular and composed of hyaline, septate and branched hyphæ, 1.8–2.88 μ in breadth. The cells penetrated by the hyphæ loose their chloroplasts and are killed. After the death of the cells the hyphæ form small knots on the surface. These gradually enlarge and darken into the black elliptical pycnia measuring 25.2–97.2 \times 14.2–42.2 μ . Sometimes a number of pycnia coalesce and measure 324 \times 108 μ . The outer wall of the pycnidia is composed of dark brown pseudoparenchymatous hyphæ about 2–4 celled thick at the lower side, becoming many celled thick towards the upper surface. The ostiole is circular and usually situated on the top. It is without a beak. The conidiophores are situated at the base and lower sides of the pycnidial cavity. The pycnosporos are biguttulate, hyaline with a greenish hue, elliptical and rounded at both ends. They are 4.32–10.8 μ long and 1.8–2.8 μ broad. In the presence of water, the spores are exuded through the ostiole in a musilagenous tendril.

Germination.—The spores germinate readily in water by giving out a germ tube from one end within 6–8 hours. The germ tube becomes septate between 8–12 hours.

Growth in culture.—The fungus grows well on Potato-dextrose-agar, Castor leaf decoction agar, Oat meal agar, and gives good growth in each. The colonies are white, circular and compact. After 4 or 5 days greenish dark spore masses appear scattered on the surface of the colony. These become black in a day or two. No pycnia are formed, the spores being produced at the apices of the hyphal branches.

Infection.—Inoculation experiments were conducted during moist humid days in the month of September. A large number of leaves were inoculated on both the surfaces with spore masses taken from culture and from infected leaf tissues. The inoculum was covered with cotton pads moistened with sterilized water. Spore suspensions from cultures were also sprayed on healthy leaves during the evening. In almost all cases infection took place. Within 3 days the inoculated parts became yellow, later becoming thin and brown, and within 8–10 days typical spots with pycnia were formed.

Infection on other parts of the plant was not successful even when the tissues were wounded.

Effect of various fungicides.—As the disease was severe during the year 1948 in the important experimental plots of the Government Economic Botanist (Oilseeds), various fungicides, e.g., Bordeaux mixture (4: 4: 50), Perenox, Spergon (in concentrations recommended for leaf-spots by the respective manufacturers) were sprayed during the month of September. Although the spraying was late, the result was encouraging. In the case of Bordeaux mixture and Perenox the growth of the spots and the pycnial formation were checked. Phygon was less satisfactory, the spots gradually enlarged but no pycnia were formed on them. Spergon was found quite ineffective. A second spraying was given after 15 days with Bordeaux mixture and Perenox. No fresh spots appeared on the treated plants.

Identity of the fungus.—So far only one species of *Phyllosticta*, *P. ricini*,* has been recorded by Rostrop from Denmark. *Phyllosticta ricini* differs from the local species in having shorter and much broader ellipsoidal spores, measuring 6.7—3.4 μ . The species occurring at Kanpur is evidently a new one having oblong slender spores measuring 4.32—10.8 \times 1.8—2.8 μ .

Phyllosticta bosensis.—Spots circular, brown, pycnidia on both sides, elliptical, black, erumpent; pycnidia from infected plants 25.2—97.2 \times 14.2—42.2 μ ; spores hyaline, one-celled, oblong, 4.32—10.8 \times 1.8—2.8 μ , biguttulate.

Habitat.—In spots on the leaves of *Ricinus communis* L.

Phyllosticta bosensis.—Maculae circulares, brunneae; pycnidia in utraque facie foliorum, elliptica, atra erumpentia; pycnidia ex plantis infestatis 25.2—97.2 \times 14.2—42.2 μ ; sporae hyalinae, uni-cellulatae, oblongae, 4.32—10.8 \times 1.8—2.8 μ , biguttulatae.

Habitat.—In maculis foliorum *Ricini communis* L.

The type specimen deposited in the Herbarium of the Government Agricultural College, Kanpur, U.P., and Indian Agricultural Institute, New Delhi.

We are thankful to Rev. H. Santapau of St. Xavier's College, Bombay, for the Latin rendering of the diagnosis.

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Botanical Section,
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January 5, 1949.

S. C. MATHUR.

* Saccardo, P. A., *Sylloge Fungorum*, 16, p. 843.

LIFE-HISTORY, BIONOMICS AND CONTROL OF SAFFLOWER APHIDS (*MACROSIPHUM JACEACE* LIN.)

SAFFLOWER (*Carthamus tinctorius*) commercially an important oil-seed crop is cultivated in Bombay Province to an extent of 6,23,582 acres. Among the various pests that damage the crop are the leaf-eating caterpillars (*Perigea capensis* Gn.) and the aphids (*Macrosiphum jaceace* Lin.). The infestation by aphids is of considerable importance and in bad years, it may vary from 60-80% in Dharwar and Bijapur districts.

Life-history of *M. jaceace* Lin. was worked out under laboratory and field conditions. On an average, the reproductive capacity of a single apterous viviparous female was 29.5 in the first generation with a maximum of 56 young ones during the life period. The duration of life-cycle varied between 7.9 to 8.3 days with four moults. In Poona, *Macrosiphum jaceace* Lin. was observed breeding on the following host plants (1) *Arctotis grandiflora*, (2) *Calendula*, (3) *Dahlia* (*Dahlia viribilis*), (4) *Ficus religiosa*, (5) *Guizotia abyssynica* and (6) *Callopsiopsis tinctora*. Besides, large number of winged aphids were seen migrating on Ganja (*Cannabis sativa*) and Jute (*Carchhorus ultitorius*), during latter part of January and February.

During the early stages of the crop in November, the pest appears and later on increases considerably reaching to a peak about a week or two before the plants develop flower buds which commence during the last week of December or the first week of January when the average temperature in 1946-47 were 79.0 max. and 66.5 min. with 68.2% humidity.

It was observed that during January and February morning temperatures usually

fall considerably which increase as the day advances. To determine the effects of varying temperatures on aphid reproduction, observations were made to study the effects of broken temperatures on their reproductive capacity by subjecting them to low temperatures for a few hours followed by normal atmospheric conditions. Three hours exposures to low temperature practically did not produce any effects. However, exposure to low temperature for 5, 7 and 9 hours affected the rate of reproduction quite adversely.

Exposure for 3 hours

	Reproduction of insects under low temperature	Reproduction in control	Per cent. fall
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Exposure for 3 hours

Average ..	9.75	9.80	0.9
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Exposure for 5 hours

Average ..	10.26	14.10	27.2
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Exposure for 7 hours

Average ..	7.16	12.45	42.4
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Exposure for 9 hours

Average ..	7.10	11.65	39.3
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Nature and extent of damage.—Observations regarding number of leaves, shoots, and heights of plants with different aphid populations on them indicated that with maximum aphid population of 568 to 1020 per plant the average Ht. of the plant was 16.8 inches with 23.5 leaves and 3.3 shoots as compared to 23.6" Ht., 82.2 leaves and 6.9 shoots in the insect-free plants.

By way of insecticidal control, fish-oil rosin-soap as well as nicotine sulphate yielded 90.91% knockdown within about 96 hours whereas DDT 0.2% spray, gam-mexane 0.2% spray and tobacco decoction gave about 82.0% mortality. Accordingly on an average, the plants treated with fish-oil rosin-soap and nicotine sulphate yielded 52.6 capsules and 1.4 oz. of seeds and 51.6 capsules and 1.3 oz. of seeds per plant respectively as against the plants treated with 3% DDT dust, 0.2% DDT spray and 5% Hexydan dust which were

almost at par and yielded on an average 40 capsules and 0.9 oz. of seeds per plant. The details of our findings will be published separately.

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N. L. HALLEPPANAWAR.

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February 4, 1949.

**A COMPARATIVE STUDY OF THE
CATALASE ACTIVITY OF THE PETALS
AND LEAVES OF *HIBISCUS ROSA-
SINENSIS*.¹**

It was noted that in some of the variegated plants, the catalase content of the albino patches of the leaf lamina was less than that of the green area. This initiated the present investigation to study the catalase activity of non-green plant organs like petals. In the present investigation, catalase activity of petals and young leaves of *Hibiscus rosasinensis* was measured and in order to further elucidate the role of the enzyme, the determinations were conducted in the early morning, noon and the evening of bright sunny days.

EXPERIMENTAL

For the determination of the catalase activity, the upper expanded portion (limb) of the petals were used. In case of leaves, lamina of young leaves (length 6.5 cm. and breadth 4.5 cm) of the terminal growing buds were selected.

The apparatus used was a modified Appleman's apparatus (Appleman¹) and the general procedure was the same as employed by Pattanaik.² After a series of preliminary experiments the following detailed procedure was found suitable.

One gram of the material (leaf or petal) was macerated with 3 gm. of calcium carbonate and the pulverizing process was limited to 2 minutes. The pulverized material was diluted to 20 c.c. with the addition of distilled water and 4 c.c. of the diluted material was allowed to react with standard dilute hydrogen peroxide (neutralised with sufficient amount of Ca-carbonate) in the reaction chamber. After the addition of the H₂O₂, the chamber was uniformly shaken for a period of 4 minutes and the amount of oxygen liberated was taken as an index of the catalase activity.

The temperature of the water-bath was kept at an uniform temperature of 30°C. for all the observations.

The data obtained in the investigation and meteorological observations are presented in the table.

TABLE

Observations on 4-10-1947 (The experiment was repeated on another Sunny day and more or less similar data were obtained)

Time	Shade temperature °C.	Light	Catalase activity Oxygen liberated in c.c.		Ratio : catalase activity of leaves/catalase activity of petals
			Petals	Leaves (mean of three findings)	
Morning 7-00-8-00	28-6	Bright sunlight	6-00	21-56	3-6
Noon 12-00-1-00	31-0	Intense sunlight	6-43	15-16	2-4
Evening 7-30-8-30	30-0	Dark	14-30	16-60	1-2

From the data it is clear that the catalase activity of the petals are less than the leaves. In case of the petals the catalase activity slightly increases in the noon but a sharp rise is obtained in the evening, when the flowers have started to fade. In case of the leaves, the results obtained for catalase activity are different. In leaves the catalase activity is high in the morning and the values obtained in the noon and the evening are comparatively low. The results obtained are interesting but further study is necessary before any explanation can be offered with reasonable accuracy.

My thanks are due to Principal Das, B.A. (Lond.), for the facilities provided for this work in the Sambalpur College and his valuable encouragement.

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March 3, 1949.

XANTHOMONAS DESMODII, A NEW BACTERIAL LEAF-SPOT OF DESMODIUM DIFFUSUM DC.

THE disease appears as yellowish brown, water-soaked, angular spots on the underside of leaves of *D. diffusum* used sometimes for green manuring at Poona. The pathogene differs from other bacterial leaf-spots of legumes in several respects and therefore it is proposed to assign it a specific rank *Xanthomonas desmodii* Uppal & Patel sp. nov.

Short rods with rounded ends, single or in pairs but never in chains; motile with a polar flagellum; capsule absent; no spores, no involution forms and non-acid fast; Gram negative; strict-aerobe; stains readily with common dyes. Colonies on neutral potato dextrose agar round, viscid, smooth, shining, wet, amber yellow with colourless margins and no internal markings. Excellent butyrous growth on potato cylinders and potato dextrose agar slants; odour is absent. Optimum temperature for growth lies between 25° and 30° C., maximum 38° C., minimum 11° C., while thermal death temperature about 50° C. Gelatin liquefied; starch hydrolysed; casein digested; litmus in milk reduced; milk peptonised; slight hydrogen sulphide produced. Ammonia and nitrites not produced; asparagine not utilised; blood serum not liquefied; no growth in Fermi's, Uschinsky's and Cohn's solutions. Acid but no gas in dextrose, galactose, lactose, mannite, maltose and sucrose; poor growth in salicin, arabinose, xylose, dulcitol, glycerol, raffinose and levulose.

Pathogenic only to *D. diffusum*, producing angular, yellowish brown leaf-spots and sometimes causing defoliation.

A detailed paper is being published elsewhere.

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March 28, 1949.

M. K. PATEL.

TRIALS OF U.S.A. HYBRID CORN (MAIZE)

* Paper read at the Botany Section meeting of the Indian Science Congress, 1943.

1. Appleman, C. O., *Bot. Gaz.*, 1910, **50**, 182.
2. Pattanaik, S. N., *Curr. Sci.*, 1946, **15**, 196-97.

IN 1947-48, 7¼ million acres were under cultivation of corn (maize) in India. Our estimated total yield was a little over two million tons, but 20% short of the demand, and 400,000 tons had to be imported from abroad. Our average yield in 1947 was

8 maunds per acre, which is $1\frac{1}{2}$ maunds lower than the average yield per acre obtained during 1936-40. In the United States of America, during the corresponding period, the average yield per acre increased from 16 maunds (1930-34) to 25.3 maunds in 1946. This increase was achieved by the use of hybrid corn seeds. In 1933, hybrid corn seeds were sown in only one acre out of a thousand; but by 1945, 675 acres out of a thousand were planted with hybrid corn. In that year, the increase of yield in the United States of America was some 17 million tons. Translated into increased income to the farmers, this meant 700 million dollars.

There are several research schemes on maize which have been sanctioned by the Indian Council of Agricultural Research, but it will take several years of co-ordinated work to evolve our own strains of hybrid corn suited to the different climatic regions of India. Experiments have recently been undertaken in this Laboratory to find out whether some strains of U.S.A. double cross hybrids could be utilised in India for increasing our yield of maize. Through the courtesy of Dr. Merle T. Jenkins, Washington, D.C., seeds were obtained for these experiments with three double crosses of hybrid corn (U.S. 13, Iowa 306 and Minhybrid 404), single cross parents of 306 and the inbred parents of all these strains.

Three sowings were undertaken at Almora on: (i) June 1st, (ii) June 25th, and (iii) June 28th, 1948.

In all these sowings the different strains of corn were planted in single rows 15 ft. long. The distance between plants was 18". The distance between rows varied according to the area available: $2\frac{3}{4}$ ft. in (i) and (ii) and 3 ft. in (iii).

In the first two sowings at Almora, 12 strains of U.S.A. inbred parents, 2 single and three double crosses, open pollinated U.P. T. 41 and Almora local strain were sown, and in the third sowing three strains of U.S. double cross hybrids, T. 41 and one Almora local strain were sown in five replications.

Despite four sowings, one each of the four inbred parents of the double crosses did not germinate, and therefore only one single cross parent each of three double crosses was produced. The single cross parents of Iowa produced vigorous plants

giving high yield of double cross hybrid seeds. The photograph, Fig. 1, shows the vigour of the single cross parents of Iowa 306, numbered 5 (AB) and 6 (CD), and a cob of 5 being pollinated by the tassel of 6.



FIG. 1. Photograph of single cross parent plants of Iowa. $\times 306$.

The average number of days required for emergence of tassel and silk in different strains of corn is given below (see Table).

It will be seen that the Almora variety was the earliest, but the life-cycles of the U.S. hybrid strains were shorter than that of U.P. T. 41.

TABLE I

Strain	Almora	Minhybrid 404	U.S. 13	Iowa 306	T. 41
Tassel ..	42.14	52.33	55.61	55.87	58.98
Silk ..	51.73	58.62	62.73	61.76	65.60

The average yield per plant of different strains is given in Table II (A), and the average yield per plot is given in Table II (B).

TABLE II

(A) Average yield per plant

Strain	U.S. 13	U.S. 306	T. 41	U.S. 404	Almora
Av. yield	9.09 oz.	6.73 oz.	3.91 oz.	3.01 oz.	0.77 oz.
	C.D. = 0.80				

(B) Average yield per plot

Strain	U.S. 13	U.S. 306	T. 41	U.S. 404	Almora
Av. yield	82.75 oz.	54.62 oz.	32.32 oz.	24.03 oz.	4.16 oz.
	C.D. = 8.15				

It will be seen that, compared to Almora local strain, the yield from all the other strains was far greater—U.P. T. 41 gave 407% and U.S. 13, 1080%, higher yield. Compared to T.41, the observed yield of U.S. 404 was 23% less, but that of the other two U.S. hybrids was higher—U.S. 306, 76% higher, and U.S. 13, 132% higher. Fig. 2 reproducing mature cobs graphically shows this marked difference.

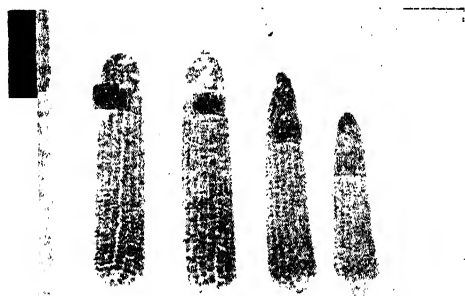


FIG. 2. Photograph of cobs of different strains of corn.

From left to right:—(i) U.S. 13; (ii) Iowa 306; (iii) U.P. T. 41; (iv) Almora local.

In view of the very high yield of the two strains of U.S. double cross hybrid corn

observed in Almora, further experimental sowings with different strains of U.S. hybrid corn should immediately be undertaken throughout India, to find out types suitable for different regions. If positive results are obtained, we could more than make up our 20% deficit in corn production by the use of hybrid seeds, without increasing our corn acreage.

In the field work efficient help was rendered by Shri. Bansilal Sah and Shri. Udinath. The data were kindly analysed by Shri. A. R. Roy, Statistician (A.H.), I.C.A.R., New Delhi. The expenses of this work were met from a grant from the Department of Agriculture, United Provinces.

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March 30, 1949.

CULTURING OF PRO-EMBRYOS OF NORMAL DIPLOID CORN (MAIZE) AGED 3 TO 7 DAYS

HAAGEN-SMIT and others (1945) who worked on corn reported that 10 day-old corn embryos over .3 mm. in length grew steadily in the culture medium. They, however, did not indicate the reaction in a culture medium of a pro-embryo less than 10 days old. In a younger kernel, the size of the embryo, it may be noted, is proportionately smaller. Further, it has been observed by previous workers, that as the size of the pro-embryo became smaller, there was a corresponding diminution in its response to the culture medium, even if the embryos were of the same age. Corn kernels collected 3 days after pollination were dissected under a dissection microscope. The seed was disinfected by dipping in S. T. 37 diluted 1:1 with water. The slide upon which the dissection was made and the forceps and the needles used for the dissection were all dipped in 70% ethanol and then passed over a flame before use. The method adopted by Haagen-Smit for dissecting the embryo consisted of holding the kernel between two slides, then cutting with a razor blade, and finally lifting the embryo out with a dissecting needle. The dissection had to be done under a dissection microscope as the embryo in this case was much younger and could not be located with the naked eye. The size of the embryo measured 70 microns in length and

32 microns in width and compares well with 0.1 mm. for length recorded for corn embryos aged 4 days (Randolph, 1936). Embryos from 4 days up to 7 days old kernels were similarly excised and all of them cultured in Tukey's general purpose medium (Tukey, 1934) to which were added certain active growth-promoting ingredients indicated in the formula given below :

10 grams KCl	} To 1½ grams of this salt mixture, add 6½ grams of agar, 25 grams of sucrose and 1 litre of water.
2½ „ CaSO ₄	
2½ „ MgSO ₄	
2½ „ Ca ₃ (PO ₄) ₂	
2½ „ FePO ₄	
2 „ KNO ₃	

*Proportion of Physiologically-Active
Ingredients*

0.2 mg. of adenine per litre of prepared solution.

20.0 mg. of ascorbic acid per litre of prepared solution.

25.0 mg. of succinic acid per litre of prepared solution.

3.0 mg. of glycine per litre of prepared solution.

0.1 mg. of nicotinic acid per litre of prepared solution.

0.5 mg. of pantothenic acid per litre of prepared solution.

0.2 mg. of vitamin B6 per litre of prepared solution.

The Tukey's medium was slightly modified by substituting 1 per cent. glucose with 5 per cent. sucrose, as sucrose is found to promote better embryonic growth in corn than glucose (Haagen-Smit, 1945). The culture bottles were kept in an incubator whose inside temperature was kept at 31° ± 1° C. The 3 to 6 day-old embryos were like tiny specks, making it hardly

possible to measure their sizes with reasonable accuracy. The 7 day-old embryo, however, was conspicuous and large enough to measure. The growth measurements for this are recorded in the table below.

The figures are averages for 5 embryos. It will be seen that the growth is very slow and retarded. At the end of the 5th day of culturing the growth, however, stopped. It was evident that the embryos of very young age, i.e., anything less than ten days, required some growth-promoting substance other than those supplied to the medium in the present experiment.

Discussion.—In this experiment it is evident that the young embryos aged 3 to 7 days were not able to mature because they lacked certain specific embryo factors necessary for further growth at this stage. It is also clear that the 7 day-old embryo was able to grow a little because it was fast developing to be autotrophic, but still wanting in certain growth hormones needed for full development. The physiologically active substances contained in the culture medium were perhaps able to supplement this deficiency to a certain extent but not fully. A similar case has been reported by White (1932). He was able to grow an embryo of *Portulaca oleracea* measuring only 0.12 mm. to a size of 1.84 mm. by adding a fibrin digest to his culture medium. The embryo, however, was unable to grow further at the end of the third week.

Agric. Res. Institute,
Coimbatore,
April 5, 1949.

P. UTTAMAN.

TABLE I

*Embryos placed in the culture medium on
Sept. 11, 1947*

Date of measurement	Length of shoot mm.	Length of Root mm.
13-9-1947	2.0	1.9
14-9-1947	2.0	2.0
15-9-1947	2.1	2.0
16-9-1947	2.2	2.3
17-9-1947	2.3	2.4
18-9-1947	2.3	2.4
19-9-1947	2.3	2.4
20-9-1947	2.3	2.4
21-9-1947	2.3	2.4
22-9-1947	2.3	2.4
28-9-1947	2.3	2.4

1. Haagen-Smit, A. J., and others, "A Method for culturing of excised immature corn embryos *in vitro*," *Sci.*, 1945, **101**, 234. 2. Randolph, L. F., "Developmental morphology of the Caryopsis in maize," *Journ. Agr. Res.*, 1936, **53**, No. 12, 881-916. 3. Tukey, H. B., "Artificial Culture methods for isolated embryos of deciduous fruits," *Proc. Amer. Soc. Hort. Sci.*, 1934, **32**, 313-22.

**THE LIFE-CYCLE OF MONILIFORMIS
MONILIFORMIS (BREMSE, 1811),
ACANTHOCEPHALA**

ALTHOUGH morphological and taxonomic studies have been made on various Acanthocephala during the last three decades, little is known about their life-cycle. The development of *Macracanthorhynchus hirudinaceus* of pigs in beetle larvae was described by Meyer (1931), and its life-history

was traced in the intermediate and definitive hosts by Kates (1943, 1944). In 1941, Burlingame and Chandler, and in 1946, Moore showed that the cockroach *Periplaneta americana* plays the role of the intermediate host for *Moniliformis dubius*, parasitic in rodents. *Moniliformis moniliformis*, which is also a normal parasite of rodents and occasionally the dog and man, is conveyed through the intermediation of the beetle, *Blaps mucronata* (Grassi and Calundruccio, 1888) and also the cockroach, *Periplaneta americana* (Seurat, 1912, and Southwell, 1922). Its occurrence in India has been recorded by Van Cleave (1925) and Bhalerao (1935). An investigation of the complete life-cycle of this thorn-headed worm was therefore considered useful.

Infective larvæ (Acanthellæ) were obtained from the body-cavity of naturally infected *P. americana* and fed in fresh condition to worm-free laboratory-bred rats. The rats were maintained under controlled conditions and autopsied after varying intervals of 1, 6, 12, 18, 41, 59, 62, 72, 128 and 147 days, and the parasitic stages were recovered and studied. In order to precisely determine the period when maturity was attained, the fæces of the infected rats were examined every day for the eggs of the worm, and it was found that in some cases the eggs appeared after 22 days and in others after periods extending up to 38 days. Thus it was observed that the *pre-patent* period ranged from 22 to 38 days. In one instance, the eggs continued to appear in the fæces for 130 days. This *patent* period indicates the duration of the fecundity of the worms. The size and structure of the worms at different ages, the ratio between the number of larvæ ingested and of adults recovered, the sex-ratio, and their location in the host-intestine, have been studied in detail.

When full-grown, the males attain a length of 32-106 mm., whereas the females measure 69-230 mm., and as many as 6500 eggs were expelled with the fæces of a rat in a day.

The fertilised egg (Fig. 1), when extruded, has four envelopes and an embryo with numerous spines. Further development is possible only when the insect swallows the fæces containing these eggs. Inside its gut, the envelopes burst and the *acanthors* emerge. These make their way out of the gut and develop into the *acanthella* (Fig. 2) in the hæmocœle. This development inside the cockroach was experimentally studied

by feeding laboratory-reared specimens of *P. americana* with the eggs of the worm. The exact duration of acanthor and acanthella stages was timed through 5, 7, 14, 21,

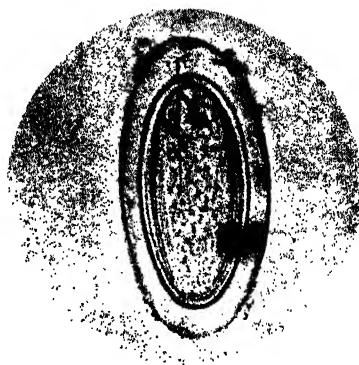


FIG. 1

Photomicrograph of egg of *M. moniliformis*, fresh from fæces of experimental rat. $\times 330$.



FIG. 2

Photomicrograph of infective acanthella of *M. moniliformis* from body-cavity of *P. americana*, without enveloping cyst. $\times 30$.

28, 35, 42 and 50 days after ingestion of eggs; of these, the first two yielded acanthor stages from the gut, and the rest pre-acanthella and acanthella stages from the body-cavity. The development of the embryo into the acanthor, its migration into the body-cavity, and the morphological changes involved in its development into an acanthella have been followed. The infective acanthella is enclosed in a delicate cyst and has a well-defined organisation in

which even sex-differentiation has taken place.

A detailed account of the above, a discussion of epidemiological considerations such as the viability of eggs and *acanthellæ in vitro*, the mode and conditions of transmission, the intensity of infections as assessed from the insect-host over a period of many months, and the possibility of other arthropod and vertebrate hosts acquiring the infection will be described in a fuller paper.

I am indebted to Dr. C. P. Gnanamuthu, M.A., D.Sc., F.Z.S., Director, University Zoological Laboratory, Madras, for valuable guidance, and to the Madras University for the award of a studentship.

Univ. Zool. Lab., (Mrs.) E. SITA.
Chepauk, Madras,
April 28, 1949.

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A MODIFIED METHOD FOR THE ESTERIFICATION OF SOME POLYHYDROXY AROMATIC ACIDS

It is known that esterification of acids can be carried out with alkyl sulphates or alkyl iodides using alkali hydroxide or carbonate in presence of suitable anhydrous solvents. In case of hydroxybenzoic acids, however, it is likely that this method may simultaneously lead to partial etherification also. The Fischer-Speier method using alcohol and concentrated sulphuric or hydrochloric acid also fails in case of some polyhydroxybenzoic acids. Thus, *o*-orsellinic acid has been esterified only by the diazomethane method,¹ and the ethyl ester had not yet been prepared from the acid. *p*-Orsellinic acid has been esterified with diazomethane and also by the action of methyl and ethyl iodides on its silver salt.² The usual catalytic method fails in these cases probably because of the ease of decarboxylation of these acids, which may be taking place due to the temperature of the reaction or the presence of the acid.

A new method has now been devised

where the esterification is carried out in a dry medium, using a neutral substance like sodium bicarbonate. By this method the methyl esters of both the orsellinic acids were prepared in high yields by refluxing for ten hours in dry acetone with sodium bicarbonate (1.25 mols.) and dimethyl sulphate (1.25 mols.). Excellent yield of the ethyl esters were obtained by similar method using diethyl sulphate (1.25 mols.) or ethyl iodide (3 mols.). It was also observed that even if excess of alkyl iodide was used, the hydroxy groups were not attacked.

α - and β -resorcylic acids also gave good yields by this method; benzoic acid itself however, gave poor yields.

This new method of esterification is a general one and would be particularly useful for some acids for which the catalytic method cannot be used. It is a good substitute to the diazomethane method having an advantage over it, that it is more simple and that esters other than the methyl can also be prepared. Moreover, it has been found to give good results even with small amount of acids.

A detailed account of the work will be published elsewhere.

Organic Chemistry Labs., P. R. SARAIYA.
Royal Institute of Science, R. C. SHAH.
Bombay.

January 26, 1949.

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SUGARCANE / BAMBOO HYBRIDS

RESEARCH work by Doctors Avdulov and Prat as also by Dr. C. A. Taylor of the Cornell University, Ithaca, New York, would appear to indicate a close relationship between the Bamboo and the Panicoid grasses to which the sugarcane belongs. When the sugarcane bamboo hybrids were first effected by me at Coimbatore in 1936 there were certain Botanists who doubted the possibility. Subsequent work on the Chromosome numbers and the morphological and the histological characters of the F.1 Hybrids at Coimbatore appear to confirm the nature of the hybrids. In the work mentioned above there is further confirmation of the possibility of hybridisation between the above two widely different genera of plants.

T. Nagar, T. S. VENKATARAMAN,
Madras,
May 30, 1949.

REVIEWS

Advances in Catalysis. Volume I. Edited by W. G. Frankenburg, V. I. Komarewski and E. K. Rideal. (Academic Press Inc., New York, 10, N.Y.), 1948. Pp. xiv + 321. 7.50 dollars.

Catalysis is one of those convenient terms that come in handy for describing a reaction whose mechanism has not been fully elucidated. The use of catalysts is none the less of considerable significance and such a large volume of work has been published, that one interested has to go through a maze of literature. The editors' remarks in the preface, "In spite of these amazing successes of catalytic methods and of our increasing knowledge of biocatalysts, only modest progress has been made in the scientific elucidation of the working mechanism and of the basic nature of catalytic action," correctly sums up the situation and one can readily understand the essentially empirical nature of the search for new catalysts. The volume under review is the first of a series which the editors are bringing out with "contributions from scientific and industrial workers that represent complete and detailed surveys of those specific sectors in which these authors are mainly interested and in which they have worked successfully." The present volume is certainly a forerunner of a welcome series fulfilling the objectives of the editors.

The first volume has eight monographs, the majority of them from industrial laboratories, all of them dealing essentially on a subject that attracted considerable attention during the war, namely aviation fuel. The opening contribution of Prof. Taylor gives an account of the work carried out in Princeton on various oxide catalysts in hydrogenation. This is followed by Ipatieff and Schmerling's contribution on Alkylation of Paraffins. It is regrettable that the scope of the article should have been restricted to only scientific literature to the exclusion of industrial applications and Patents. The reviewer is unable to accept the statement in dealing with halide catalysts that "aluminium chloride and boron fluoride, being electron acceptors, are *per se* acids, in the modern meaning of the word". G. N. Lewis' definition expounded by Luder referred to here has not yet received universal acceptance and is not without its drawbacks. In dealing with the mechanism of the reaction the authors are using an

anionotropic mechanism which appears to rest essentially on qualitative behaviour without reference to the rate factor. This is clearly an unsatisfactory position requiring further experiments. The article gives a good comprehensive survey of the use of various catalysts in the alkylation reactions.

The use of the Brunauer, Emmett, Teller Equation in the measurement of surface areas of finely divided or porous solids is well illustrated by Emmett's contribution, which includes short critical accounts of other methods, as well as the limitations of gas adsorption methods in general. Griffith's 'Geometrical Factor in Catalysis' strikes new ground indicating a fruitful line of work both on the experimental and on the theoretical side. Dr. Storch's account of the Fischer-Tropsch and related processes fully conforms to the aims of the publication. Besides a useful account of the experimental and theoretical side of the problem of chemisorbed hydrogen, Dr. Eley's monograph is particularly interesting for a brief survey of biological activation of hydrogen and a picture of the transition state as a ring of mobile electrons.

The longest monograph in the volume is the one on alkane isomerisation, the lower members naturally covering the greater part. Both the experimental and mechanistic side find adequate treatment and there are clear indications of the need for further work. The concluding article by Jellinek and Fankuchen gives an account of the exploratory work on the application of X-ray technique in the study of this complex field of heterogeneous catalysis.

Attention has to be drawn to the use of certain terms and contractions not universal but which are presumably normal in American practice: 'alkylate' is used as a noun and 'p.s.i.' presumably stands for pounds per square inch. The reviewer came across a few misprints, one on p. 46 has a missing word. The reference to the paper by Horiuti and Polanyi is wrongly given on pp. 82 and 103 as Horiuchi and Polanyi.

The get-up and production of the book is of the standard that one has come to associate with standard American scientific publications.

The volume should find a place in every library, both academic and industrial, particularly where heterogeneous catalysts are being used or studied. The contents of the second

volume given in the inner flap of the outer wrapper serves as an appetiser for the next volume.

S. V. ANANTAKRISHNAN.

Foundations of Modern Physics. By Thomas B. Brown. (John Wiley & Sons, Inc., New York, Chapman & Hall Ltd., London), 1949. Pp. 390. Price sh. 5.00.

The book under review is yet another addition to the large number of books on modern physics which have been published in recent years. Modern physics is an elastic term. Broadly speaking, it includes those discoveries and developments which may have become classic to the physicists, but still may be considered new to scientists generally, as well as to the average well-educated man. The first edition of the "Foundations of Modern Physics" appeared in 1940. It was based on a course of lectures on modern physics given by the author at the George Washington University as the fourth unit of a two-year general course in physics. According to the author, the purpose of the book is to survey the present knowledge in the various fields of modern physics and to acquaint the reader with the methods employed by scientists in their search for more knowledge. The second edition which is being reviewed here has been revised to include the recent advances in physical knowledge. Notable changes are the following: The last three chapters on nuclear physics and cosmic rays have been rewritten and expanded into four chapters. The material on kinetic theory and electronics has been revised, and Chapter V on "Electrical Oscillations and Electromagnetic Waves" has been expanded to include micro waves and radar. An "Introduction" and an "Epilogue" have been added to explain the objective and the philosophy of the book.

The book may be divided roughly into four parts: The first part which includes Chapters I to VI, concerns what may be referred to as particles which behave as particles and waves which behave as waves. The particles include electrons, atoms and molecules and here we are concerned with their physical properties, such as mass, volume and electric charge, and with methods for measuring these properties. Waves include the entire electromagnetic spectrum from radio waves to X-rays, and we are concerned with the methods for identifying these radiations, measuring their wavelengths,

and studying their properties. The historic proofs for the wave character of light are included as necessary background and support for the same methods when applied to the newer portions of the spectrum. The applications related to this section include a large part of electronics, radio, and X-rays.

Part two, which includes Chapters VII to X, relates generally to the dual wave-particle aspects of matter and energy, or to the particle characteristics of waves and the wave characteristics of particles. Here are encountered the fundamental concepts of the quantum theory, beginning with Einstein's explanation for the photo-electric effect. Here belongs also an elementary consideration of atomic structure, as revealed by the data of spectroscopy. Applications include electron lenses and the electron microscope.

Part three, Chapters XI to XIV, is concerned chiefly with the kinetic theories for atoms and molecules in solids, liquids, and gases, electrons within metals, and photons in black-body radiation. It gives brief consideration also to molecular forces and crystal structure.

The fourth and concluding section surveys nuclear physics and the physics of elementary particles, including the important topic of nuclear or "atomic" energy. It begins with Chapter XV, on radioactivity, and runs through Chapter XIX on cosmic rays.

A list of problems and references for advanced reading is given at the end of each chapter. The problems have been so chosen as to supplement the text by bringing out additional points of interest. Six appendices are also included dealing respectively with units, universal physical constants, periodic table of elements, period of oscillation of an oscillating electric circuit, relativity and theory for radioactive decay. The book is adequately illustrated with diagrams and photographs.

The author has attempted to cover the entire subject of modern physics in this handy little volume. The treatment is simple and to the point. Emphasis throughout is laid upon the experimental aspects of the subject and upon the evidence which these experiments give in support of the new theories. The book can therefore be easily followed by students of physics who are not familiar with advanced mathematics. The reviewer feels that this book can be recommended for use by the physics honours students of Indian Universities.

R. S. K.

Photography in Crime Detection. By A. J. Radley, M.Sc., F.R.I.C. (Published by Chapman & Hall, London), 1948. Pp. 186. Price 21 sh.

Crime plays, and has always played an important role in the life of mankind since immemorial time. In the current century, it is said, crime has become a refined scientific pursuit. Those who fight against crime are therefore facing the need for utilising all the advances of modern science for detection and prevention of crime.

In this book "Photography in Crime Detection" the author has managed to pack, within 186 pages, a staggering amount of information on the various uses of modern photographic processes in detection, analysis and proof of crimes. While keeping within limits of popular appeal, the author has made the chapters intensely practical, and valuable alike to the working detective or legal adviser, as to the general reader who finds interest and diversion in greedily imbibing detective fiction.

After a theoretical introduction concerning the role of photography in crime detection, the author goes on to discuss cases involving mechanical vehicles, identification of persons, criminal cases such as murder, house-breaking, sexual offences, counterfeiting coins, gems and precious stones and betting offences. The examination of documents which are disputed on the ground of forgery and the photographing of such documents by normal and oblique lighting for purposes of comparing handwriting, identification of inks, detecting alterations, erasures or additions, etc., are dealt with in detail in a long chapter covering nearly 30 pages. The use of ultra-violet light and fluorescence analysis of documents, photographing documents, fingerprints, etc. by fluorescent light, ultra-violet light and infra-red light are covered in a very practical manner under separate chapter headings. The place of photomicrography and X-ray photography in crime detection is rightly emphasised and exhaustive practical information given under relevant chapter heads.

On the whole the book is an admirable condensation of very useful and important information on all aspects of the subject, and at the end of each chapter there is a bibliography which helps to the reader to refer to other literature on the subject for additional information.

No less than 104 reproductions of photographs actually used in various criminal cases illustrate the book throughout, thus clarifying the textual material by visual illustration.

The author deserves special commendation in keeping one main principle in view, which he states in his preface: "Every effort has been made to present the material in the simplest manner possible and the examples have been selected for their value in *illustrating the various techniques* rather than for their sensational value."

Professional men in the police departments and lawyers and judges will find much of real value in this book, while photographers, both professional and amateur, will realise that their fellow-photographers who do specialised work in police laboratories or in forensic science laboratories rank among the best exponents of photographic technique and ingenuity.

S. LAKSHMINARASU.

Biochemical Evolution. By Marcel Florkin. Edited, translated and augmented by Sergius Morgulis. (Publishers: Academic Press, New York), 1949. Pp. 157. Price \$ 4.00.

The purpose of the book is to focus the attention of interested workers on the probability of finding a biochemical basis for the evolutionary changes in the animal kingdom. Morphological considerations have dominated till recently the studies dealing with evolution and zoological classification. It was time that the relation between form and the biochemical processes was taken into consideration in greater detail. Not that it has not been done. But the present volume succeeds in doing it within the limited space of 143 pages of a well-documented book. The information on biochemical systems, adaptations and characteristics which has been laboriously collected in various laboratories and in the collection of which the author himself has been well to the forefront has been ably marshalled and presented in this small volume in support of the main thesis. The material contained therein does provide considerable evidence in support of the thesis propounded by the author. At the same time it also shows up several gaps which exist in our knowledge. The author's contention that form is the resultant of an interaction of biochemical systems with molecular and submicroscopic architectural patterns is one which appeals to the biochemist, but it will be agreed that considerably large body of information will have to be collected before this concept is widely accepted. Evidence is not wanting to suggest that systems like osmoregulation, respiration, digestion, etc., as well as metabolic patterns have closely accompanied the morpho-

logical evolution in the animal kingdom. Only further work will show whether they have determined the form or have been themselves determined by the latter. There is no doubt that whichever way it turns out to be, the biochemical concept of evolution is certainly very attractive and is bound to stimulate further intensive effort.

V. N. PATWARDHAN.

Birds in Britain. By Frances Pitt. With 17 coloured plates and numerous photographs and figures in the text. Pp. viii + 576. Size 9" x 6". London, 1948, Macmillan & Co. Ltd.

It is a significant tribute to the enthusiastic and everwidening circle of bird-lovers in Britain that every passing year is enabled to add its quota to the already imposing array of British bird books.

Frances Pitt, the present author, needs no introduction. Her frequent contributions to *Country Life* and similar periodicals have delighted readers for upwards of 3 decades and so have her several books on natural history subjects, of which one that this reviewer can recall with especial satisfaction is "Wild Creatures of Garden and Hedgerow".

Referring to the number and variety of books on British birds already in the field, Miss Pitt in her Preface says "... nevertheless there seemed space for yet another, a survey of the bird life, wild, feral and domestic in Britain, which would tell concisely of their status, appearance and habits with the special view of assisting the recruit to the study of ornithology". How well the book fulfils its purpose will be evident from its contents and treatment.

The first 90 pages (Part I) are devoted to a general review of the Class Birds. It is divided into 5 succinctly written sections: The Bird's Place in Nature, Structure of a Bird, Distribution of Birds, Migration of Birds, and Bird Behaviour. To indicate the comprehensive nature of the topics covered by the sections, some of the sub-titles may be quoted: Classification of Birds, Birds in Britain, Birds and Plants, Domestic Birds, Bird Sanctuaries, Feathers, Moults, Ancestry, Sexual Selection, Protective Colouration, Adaptation to Environment, Limitation of Dispersal, Adaptation to Special Conditions, Rise and Fall of Species, Formation of Geographical Races, Causes of Migration, Migration and Natural Selection, Bird-ringing Schemes, Instinctive Nest-building, Parental Care, Courtship Rites, Song, Social Gatherings, Territory, etc.

A notable omission is *The Bird's Egg*, which seems curious considering what an important phase egg-collecting constitutes in the life of the average British schoolboy, and what a number of distinguished ornithological careers owe their beginnings to this largely nefarious activity.

The accounts are interspersed with legends, popular superstitions, folk-lore, personal anecdotes and well selected verses and quotations about birds, which enhance the interest and readability.

Side accounts, for example the history of the canary, now such a favourite cage bird in Europe and elsewhere, are revealing. The original canary is a native of the Canary Islands, Azores and Madeira. It is a plain looking greenish-grey little bird closely allied to the finch known as *Serin* (*Serinus canarius*), with nothing particularly remarkable about its song. The yellow canary, as seen in cages, is a colour-mutation stabilized by artificial selection and breeding—more or less on a par with the blue variety of the Australian Grass-parakeet or Budgerigar so fashionable with fanciers at the present day. The sustained and spirited rolling song of the tame canary is of course largely the result of training.

The Turkey, found wild only in the New World, was apparently first domesticated in Europe in the 16th century. Unfortunately we are not told how, and since when, it has come to be so intimately associated with Xmas particularly in Britain and her colonies.

Many of the other topics dealt with are of far more than a circumscribed ornithological interest. They treat of aspects of birds and their study which even the browsing general reader will enjoy and profit by. In regard to migratory starlings carrying the virus of foot and mouth disease of cattle from the Continent to England, the author writes "But there is no direct evidence of any kind to confirm the suspicion, only circumstantial evidence being available, and the accusation may rest on nothing more than coincidence". But the fact that outbreaks generally start near the east and south-east coasts of England where continental starlings arrive, and do not occur in Scotland where migratory starlings do not go, seems to us something more than mere coincidence.

Some naturalists apparently still believe that the "bleating" of the Snipe during its aerial nuptial display is vocally produced.

That this, in fact, is a purely mechanical sound produced by breeze rushing through the

widely spread outermost tail-feathers was proved once again by the author's experience of the snipe tail-feathers which she had struck in her hat band. The breeze blowing through the feathers caused them to vibrate and emit the characteristic "bleating". Taking off the hat ended the music; replacing it on her head started it again.

This reminds us of the similar controversy of a more or less perennial nature in regard to the "drumming" of woodpeckers. One school maintains that the sound is purely vocal, the other purely mechanical. The fact that drumming on a steel telegraph post produced a metallic sound, as recorded by one observer, would seem to settle the point but it has evidently not done so!

The enigma, experienced by all aviculturists, of certain species of wild birds which become perfectly tame and reconciled to captivity and yet consistently refuse to breed under these conditions, though other closely allied species do so freely, is difficult to explain and calls for closer investigation.

Part II of the book describes the families and species of birds, common, rare, and those introduced into Britain as livestock or as cage birds. This part follows the same systematic order and arrangement as Witherby's standard 5-volume "Practical Handbook of British Birds", beginning with the Crows and ending with the Game Birds.

The book is pleasing to handle and well printed both as regards text and the illustrations (chiefly photographs), which are numerous and well chosen. The coloured frontispiece of Goldfinches by Winifred Austin, and the coloured plates by the well-known bird artist Rowland Green, form an attractive feature. They depict in all about 92 species of the commoner birds of Britain. Bird-lovers in every country will welcome this latest addition to Messrs. Macmillan's "In Britain" series, of which 3 other uniform volumes—"Flowers in Britain", "Trees in Britain" and "Dogs in Britain" have so far been published.

S. A.

Handloom Weaving Industry in India.

By M. P. Gandhi. (Published by M/s. Gandhi & Co., Jan Mansion, Sir Pherozeshah Mehta Road, Bombay; Post Box No. 80), 1948. Price Re. 1-8, with a Foreword by H. E. Sri Mangaldas Pakvasa.

This is the third monograph on the most important small-scale industry in the country by an author well known for his various publica-

tions on the economic problems of our Textile Industry. Like its immediate predecessor (reviewed in *Current Science*, Vol. 16, No. 11) it contains a wealth of useful information on the past struggles, existing difficulties and future possibilities of this ancient industry. Besides giving copious extracts from the reports of the meetings of the All-India Handloom Board and its various Committees and the report of the Fact Finding Committee who have made a first hand study of the problem, the author ventures useful suggestions not only for the preservation but also for the development of this important industry whose survival would make all the difference between existence or otherwise to nearly ten million people depending directly and indirectly on it.

In a short Preface the author summarises the existing conditions *vis a vis* Government efforts and indicates the possible lines of development like statutory percentage allocation of mill yarn and standardisation of its strength, formation of co-operative societies for supply of raw material and sale of finished cloth, transport facilities, novel designs, research on processes and material, use of mixture yarns, etc., which are quite practical. An all-India organisation embracing various aspects of the Industry is envisaged to enable active steps being taken on these lines. Standardisation of handloom goods both in quality and price is proposed though perhaps the survival value of the handloom lies in the long run in its richness of variety. The importance of research and marketing facilities is rightly stressed. Lack of finish, for instance, which robs the handloom goods of sales appeal, could be remedied by research and centralised finishing organisation.

Giving a historical review, the impact of the growth of the Mill Industry as well as the competition from the small-scale Power Loom Industry are briefly discussed. The vital importance of this long established industry which still produces 1,300 million yards or nearly 25 per cent. of the country's cloth production valued at 100 crores of rupees and employs nearly 2½ million hands against a three-quarter million employed by the Mill Industry, to the economic structure of the country is vividly portrayed (the effect of the division of the country on these figures requires scrutiny).

The author's own remarks are so freely interspersed with the extracts from other reports that it is often difficult to distinguish one from the other. Division into chapters and an index would be more useful. While there are few misprints 'shapes' and 'shares' (page 38) should

read 'shades'. The author would do well to revise the table on pages 64 and 65 which show certain discrepancies in figures, and incorrect totals. The obsolete 'Art Silk' should be replaced by 'Rayon'.

Mr. Gandhi deserves the congratulations of everyone interested in the welfare of the millions of our countrymen who depend almost entirely on this Industry for their livelihood, for presenting a clear and stimulating picture of the problems of the handloom industry, as well as its national importance and pleading for a vigorous and concerted action on the part of the Government and those engaged in the Industry.

Srinagabhushana.

Report of the Planning Committee for Geophysics. (Printed by the Government of India Press, Calcutta), 1948. Pp. 1-103.

The Government of India had constituted a Planning Committee in January 1946 "to consider and report on the question of organizing and developing in India institutions dealing with the study of Geophysics". This Committee held seven formal meetings in all, but considerable work is also said to have been done through informal discussions between the members. The Committee took stock of the contributions to Geophysics—both in the scientific and economic aspects—which have been made in this country. The scope for further development in each of the branches of the subject was considered, and a number of recommendations have been drawn up giving the lines on which the work in future should be carried out. These recommendations have been submitted to Government of India for consideration.

The Report under review presents a comprehensive account of the deliberations of this Planning Committee, in five chapters. A summary of their main recommendations is given in Chapter Six. There are also elaborate Appendices recording twenty-four important Notes and Papers submitted to the Committee. Most of these papers give a succinct exposition of the data and knowledge which has been so far obtained in the country by measurements of Gravity, Terrestrial Magnetism, Atmospheric Electricity, Hydrology, Oceanography and also of the progress made in Geophysical prospecting.

In regard to the measurements of Gravity, the Survey of India have formulated a scheme to cover the whole country with a network of gravity stations at intervals of 10 miles. The new type of Frost Gravimeter which is capable

of making rapid measurements of gravity with great accuracy, has been obtained by the Survey of India. The Planning Committee have recommended that high priority should be given specially to cover the areas constituting: (i) the south and south-eastern margin of the Deccan traps, (ii) the eastern margin of the rocky terrain comprising the coalfields in Bengal, and (iii) the northern border of the Vindhyan plateau and south eastern Rajaputana. It is now learnt that the Survey of India have, during the last year, already started the gravimetric survey in the Raniganj area. The results of this survey will be watched with keen interest.

In respect of Seismology, the Committee have recommended that seismograph stations with modern instruments should be set up in the earthquake zones of India. More especially, it has been urged that steps should be taken up immediately for the study of earth movements at sites of big dams like the Sukkur Barrage in Sind. (It must be remembered that the constitution and deliberations of the Committee took place before the political partition of India) and the proposed Dam sites of the Kosi, Damodar and other projects. The memorandum on a plan for a seismological station network in India with reference to the Kosi River Project, by the U.S. Coast and Geodetic Survey, given in Appendix 9, furnishes some brief descriptions of the different instruments outlining their basic operating characteristics, and cost. The policy to be adopted in planning stations and their distribution, with a reference to the engineering problem, have also been given. The Director-General of Observatories in India has obtained sanction for the purchase of some of the instruments, and further work on the lines suggested by the Committee is very likely under progress now.

The study of secular variations in Terrestrial Magnetism in India for some years has suffered owing to the absence of observatories at suitable centres. The Committee have recommended that the number of magnetic observatories should be increased to five as in the past. They have agreed to the shifting of the Alibag Observatory to another location which is not likely to be affected by electrical installations and other encroachments. Recommendation has also been made that the Survey of India should take magnetic observations on a fundamental grid all over the country with stations at 10 miles interval.

With regard to Hydrology, a number of recommendations have been made, chiefly relat-

ing to the Rainfall registration and returns, increasing the number of stations recording temperature, setting up stations for observations of snow-fall and snow surveys in the Himalayan catchment, collection of information on ground-water supplies, systematic river-gauging and standardisation of data, and also the determination of water balance in selected catchment areas.

Development of Oceanography in India has also been considered by the Committee and a note on this subject by Dr. K. R. Ramanathan furnishes a brief resume of the researches so far carried out in the Indian Waters. The importance of studies of oceanography—both as a fundamental science, and for its practical usefulness in the development of Fisheries, Navigation and Meteorology—have been pointed out. The Committee have recommended that the plan for development of Oceanography should be worked out by another Committee—an enlarged one including themselves, with representatives of the Royal Indian Navy, the Zoological Survey of India and the Departments of Fisheries in Provincial Governments.

Geophysical prospecting—i.e., the application of Geophysics to the location of hidden mineral deposits, structures and other economic and engineering problems—has also been considered by the Planning Committee. Their resolution is to the effect that it “welcomes the formation of the Geophysical Section of the Geological Survey of India and recommends that all possible assistance should be given to the Geological Survey by Government and other Scientific departments for extending their geophysical activities.” The programme of the Geological Survey of India is stated to concentrate for the moment on numerous immediate problems connected with dam foundations, river sand supplies, metalliferous and coal deposits, etc. As a long-range scheme they will keep in view the program of the study of the bottom of the Indo-Gangetic trough. The building up of a Laboratory and research organisation at Headquarters, has also been taken up.

In respect of Geophysical Prospecting, the Planning Committee have laid some emphasis on the opportunities that may await the geophysicist in discovering mineral deposits possibly hidden under thick overburden in 500,000 square miles of alluvial tract, and in about 200,000 square miles of area covered by the Deccan Trap. If one were to add to this, the coastal strips covered by the sea, we could count on quite an immense area for geophysi-

cal exploration in India. But these are not problems easy of solution, and in the present context of the country, the examination and development of some of our known mineral fields where the outcrops of ores and other useful minerals may lie concealed under a veneer of soil and debris, are more important. The case for geophysical exploration for oil stands on a different footing, and opinion can be sharply divided on this question whether Government could effectively undertake such ventures and spend many lakhs of rupees a year on a speculative basis, or whether the matter should be left aside for private enterprise. There is no indication in the Report that the Planning Committee have examined this question. The terms of reference for the Committee were very wide and general, and also as Dr. Dessau has remarked elsewhere, “amongst members of the said Committee people with practical experience in geophysical exploration and representatives of the oil and mining industries where such methods are chiefly employed were but meagrely represented.”* Naturally, under these circumstances, some of the important questions relating to geophysical exploration in India have failed to receive consideration.

The Committee have appreciated the need for establishing facilities for imparting instructions and practical training in the geophysical methods. They have considered a detailed plan prepared by Prof. M. N. Saha for starting a Central Geophysical Institute in India. This plan presents very carefully worked out proposals outlining the courses of study, laboratory and other equipment, building, personnel, etc., required for the Institute. The Committee however have not accorded a priority to this scheme but recommended that Universities should offer facilities for teaching geophysics for the M.Sc. courses, and that the Central Government should give financial aid to such Universities as are prepared to do so. At present even combination of Physics or Mathematics with Geology is not permitted in most of the Universities in India. It is doubtful if any Universities will respond in a liberal measure to the Committee's recommendation. The Indian School of Mines at Dhanabad could easily start a geophysical section on the model of the Colorado School of Mines. In some

* G. Dessau: “Past & Future of Exploration Geophysics in India”, *Trans. Mining, Geological & Metallurgical Institute of India*, September 1947, 43, p. 43.

respects, this may have more advantages than starting an independent Geophysical Institute.

Finally, the Committee have recommended the formation of a National Committee of Geodesy and Geophysics, and also a Central Board of Geophysics. The National Committee is proposed to take steps for its affiliation with the International Union of Geodesy and Geophysics, while the Central Board is to function

as a Standing Committee for co-ordination of the geophysical work carried on by the various scientific departments and Universities.

On the whole, the Report of the Planning Committee constitutes a valuable scientific document, while the recommendations if given effect to, would lead towards a progressive and integrated knowledge of Geophysics in India.

M. B. R. RAO.

SCIENCE NOTES AND NEWS

Lady Tata Memorial Trust

The Trustees of the Lady Tata Memorial Trust announce on the 18th June 1949, the death anniversary of Lady Meherbai Dorabji Tata, awards of scholarships and grants for the year 1949-50.

The international awards of varying amounts (totalling £3000) for research in diseases of the blood with special reference to Leucæmias are made to Doctors Edith Paterson (England), M. C. Bessis (France), J. Bichel (Denmark), Pierre Cazal (France), J. Clemmesen (Denmark), C. F. M. Plum (Denmark), E. Kelemen (Hungary), Edoardo Storti (Italy), Charles Oberling (France), Jagdish Chandra Mehta (India), Pascou Atanasiu (France) and Gunther Schallack (Germany).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Messrs. Gangagobinda Bhattacharya (Calcutta), Bimal Kumar Sur (Mysore), K. Ramamurti (Bangalore), Gauranga Roy (Calcutta), D. V. Siva Sankar (Madras) and P. R. Srinivasan (Coonoor).

Director of Geological Survey

Dr. M. S. Krishnan, Director of the India Bureau of Mines, New Delhi, it is understood, has been appointed to act as Director of Geological Survey, in the place of Dr. W. D. West who is proceeding on leave. Dr. Krishnan is the first Indian to be appointed to the post.

Award of Research Degree

The Syndicate of the Andhra University have resolved that Mr. C. Ramasastry, M.Sc., be declared qualified for the degree of Doctor of Science (D.Sc.) on the recommendation of the Board of Examiners consisting of: Dr.

R. W. B. Pearse, Dr. R. F. Barrow, Prof. W. Jevens appointed to adjudicate on the thesis entitled "Band Spectra of the Diatomic Halides of Zinc, Cadmium and Mercury and Spectrum of Triatomic Molecules CS₂."

World Medical Conference

The general conference of the World Medical Association is being held in London this summer.

Sixteen nations are preparing the agenda at preliminary committee meetings. These are now proceeding in Madrid.

World Tuberculosis Conference in London

Representatives from all over the world—from 33 different countries, including all those of the Commonwealth—are to attend the second Commonwealth and Empire Health and Tuberculosis Conference, to be held in London from July 5 to 8.

The Conference, which is being arranged by Britain's National Association for the Prevention of Tuberculosis, will give special attention to Commonwealth questions but the opening session will be devoted to tuberculosis as a world problem because it is against this background that all other problems must be considered.

India will be represented at the Conference by a delegation of five. It will consist of Dr. P. V. Benjamin, a member of the Tuberculosis Association of India, Major Khushdeva Singh, Dr. Ram Chandra Adhikari, Dr. P. K. Ghosh and Captain S. D. Sharma. Dr. Benjamin, who read a most interesting paper at the last Conference, will be one of the speakers at this year's Conference.

One of the most interesting features of the Conference will be an exhibition illustrating

the most modern methods in the diagnosis, treatment and prevention of the disease, both scientific and psychological.

On the scientific side there will be exhibits illustrating the manufacture and use of the new drugs Streptomycin and para-Amino-Salicylic Acid and an X-ray demonstration unit with a darkroom in which films will be shown. On the psychological side the Art Therapy exhibit will be especially interesting as this scheme, started by the N.A.P.T. three years ago, has now been adopted with great success in over 100 sanatoria.

The Royal College of Physicians, the Matrons and Medico-Social Sections of the N.A.P.T., and the journal *The Practitioner* are planning to give receptions for Conference members. There will be a large choice of specially arranged visits of medical interest to such institutions as Brompton Hospital for Diseases of the Chest, the King Edward VII Sanatorium at Midhurst in Sussex, Papworth Village Settlement at Cambridge, and Harefield County Hospital, Middlesex.

Study Grants for Indian Scholars

Under the scheme for the promotion of interchange between British Universities and those in Commonwealth countries, the British Council has awarded travel grants covering return fares to Mr. O. P. Bhatnagar, Lecturer in History at Allahabad University, and to Mr. B. Bhattacharya of Benares Hindu University.

Mr. Bhatnagar will visit London University and Mr. Bhattacharya will study spectroscopy at Cambridge.

200th Anniversary of Dr. Edward Jenner

To commemorate the 200th anniversary of the birth of Dr. Edward Jenner, the British physician who introduced to the world the technique of vaccination, an exhibition has been arranged in London.

It was in 1798 that Dr. Jenner first placed before the world the results of his researches into the possibilities of vaccination. This new technique soon spread to all parts of the civilised world and by 1800 had become recognised medical practice. He was the first person to introduce the idea, and the first to have the courage to test his theories in practice.

It was not till about 80 years later that Pasteur extended Jenner's discovery by using vaccination against cholera and anthrax. It was he who

proposed a meeting of the Medical Congress in London, that vaccination be officially adopted as the term for this method of conferring immunity from infectious diseases. He suggested this as a "homage to the merit and immense services rendered to medicine by one of England's greatest men, Dr. Jenner".

Los Angeles Arboretum

Dr. Frans Verdoorn, who has been Director of the Los Angeles State and County Arboretum at Arcadia near Pasadena, California, since last autumn, will return to his editorial, historical, and international relations work at Waltham, Massachusetts on April 15, 1949.

It is with deep regret that the Trustees of the California Arboretum Foundation, Inc. accept his resignation on completion of the initial organizational phase in the development of the Arboretum. Its office, library and the Southern California Horticultural Centre have been established, and preliminary landscaping plans (by Architect Bent) have been completed, and a Biological Survey of the Arboretum area is well under way.

Dr. Verdoorn will continue to serve the Arboretum as a Councillor.

Pending the appointment of a new Director, Wm. Hertrich, Curator Emeritus of the Huntington Garden, and a member of the Arboretum Board of Trustees, will supervise horticultural activities, Mr. Howard Miller, of the Los Angeles Chamber of Commerce, the general office, and Mrs. Richard Dakin the historical reconstruction work.

George Spalding, Propagator at the Arboretum, has been appointed Acting Superintendent.

Indian Standards Institution (ISI)

The International Organisation for Standardization (ISO) is holding a number of Conferences in Paris from the 25th of June to 11th of July next, at which India will be represented by Dr. Lal C. Verman, Director of the Indian Standard's Institution (ISI). Apart from the ISO Council, of which India is an elected member, the General Assembly of the ISO, on which 27 leading nations of the world are represented, will meet for the second time since its inauguration in 1946 in London. Ten of the 69 Technical Committees of the ISO are expected to hold working sessions in which concrete proposals for international standardization of several subjects will be discussed and programmes for future work in these fields will

be laid down. Revision of ISO statutes will also be considered by a Special Committee of the ISO Council, of which Dr. Verman is a member.

Dr. Verman, who will be leaving for Paris on the 24th of June, has been selected by the ISI to represent India in all these conferences of the ISO. It is anticipated that he will take this opportunity to hold informal consultations with delegates from other countries concerning international standardization of Shellac and Mica in which India is most interested from the export point of view, and for which India has been entrusted with the secretariats of the ISO Committees. The ISI had already circulated draft proposals for standardization in these two fields to all the ISO Members interested in the subject and Dr. Verman will endeavour to arrange that it should be made possible for the ISO Committees on Shellac and Mica to meet in India during the coming winter.

Brazil's Jute Industry

A campaign for an all-out Government support to Brazil's jute industry, which is reported to have made a "miraculous recovery", has been launched by a united front of cultivators, manufacturers and exporters, reports the May issue of the *Jute Bulletin* recently released by the Indian Central Jute Committee. Trade circles in Rio de Janeiro believe that Brazil which is now producing sufficient bags will eventually be able to produce surplus jute for export. There was a storm of protests from sacking manufacturers and exporters alike when a bill seeking to allow duty-free importations of used jute bags was recently introduced in Congress.

Recent production figures from Amazonas and Para, whose combined output jumped from less than one million kilos in 1941 to more than 7 million kilos in 1947, provide reasonable basis for the prediction made by the Rio Weaving Syndicate that complete self-sufficiency would be achieved by Brazil in 1949. It is estimated that the 1949 crop will be three times the 1947 figure. Conversely, imports of Indian jute dropped from over 25 million kilos in 1938 to only 10 million in 1947.

At present imported jute constitutes 40 per cent. of the raw material consumed by Brazil's 33 sacking factories. The other 60 per cent. is

indigenous and includes Caroa and several other native fibres grown in Northern States. Last year 32 million jute bags crossed Brazil's borders carrying exports of various agricultural produce.

Experimental Cell Research

A new journal is about to be launched under the auspices of the International Society for Cell Biology.

Experimental Cell Research will publish papers dealing with experimental analysis of the activity, structure and organization of the cell and its subunits, including work on virus. Technical or theoretical papers aiming at the further development of methods in the field of experimental cytology will also be included. Papers may be submitted in English, French, or German.

Experimental Cell Research will be edited by Törbjörn Caspersson, Stockholm; Honor Fell, Cambridge; John Runnström, Stockholm; Francis O. Schmitt, Cambridge, Massachusetts; Paul Weiss, Chicago, Illinois; Ralph W. C. Wyckoff, Bethesda, Maryland. J. F. Danielli, London, will act as editor of communications from the Society for Cell Biology.

Authors residing in the Western hemisphere should send their papers to U.S. editors; those residing in the British Isles should mail them to Dr. Honor Fell, Strangeways Laboratories, Cambridge; papers originating in other countries should be forwarded to the Scandinavian editors.

One volume, consisting of four issues, will be published annually.

The new journal will be released under the imprint of Academic Press, Inc., New York.

ERRATA

Vol. XVIII, No. 5, May 1949, pages 180-81
Note on *Cerebella* on Sugarcane :

In the heading
for "*Cerebella* on Sugarcane" read "*Cerebella* on Sugarcane ergot".

p. 181, line 3, for "inhibit scleritrial development" read "inhibit scleritrial development".

p. 181, para 2, line 7, for "suppressing the sclerotial stage" read "suppressing the sclerotial stage".

Current Science

Vol. XVIII]

JULY 1949

[No. 7

	PAGE		PAGE
Food Self-Sufficiency by 1951 ..	229	1851 Exhibition Scholarship ..	237
Edward Jenner, 1749-1823 ..	230	<i>An Apparatus for the Coronary Perfusion of the Mammalian Heart</i> —K. N. GOVINDAN NAYAR ..	238
<i>The Indian Institute of Science and the Egerton Committee Report</i> —M. R. NAYAR ..	231	Honey Hunting ..	240
<i>The Theory of the Christiansen Experiment</i> ..	232	Letters to the Editor ..	241
Dr. Chandrasekhar ..	232	Reviews ..	262
<i>Chemotherapy of Tuberculosis</i> —C. V. DELIWALA, K. GANAPATHI AND S. RAJAGOPALAN ..	233	<i>Science Notes and News</i> ..	266

FOOD SELF-SUFFICIENCY BY 1951

ONE of the colossal ventures on which the Government of India have embarked and one of the biggest challenges which they have accepted is, according to the Minister for Food and Agriculture, to deliver the country from the bondage of foreign food. The overall picture of the food deficit can be gathered from the data furnished by Government experts who have carefully examined the situation. Their findings record a 10 per cent. deficit of cereals, a 20 per cent. deficit of pulses, and a 150 per cent. deficit of fats. For meat, fish and eggs together, a three hundred per cent. deficit is recorded. The country suffers from a 200 per cent. deficit with respect to vegetables while with regard to fruits the deficit rises to 300 per cent. The deficit with regard to milk which is considered an essential nutrient, amounts to 350 per cent. When these deficits are made up, it is considered that the Nation would be in a position to feed itself adequately and in accordance with modern standards of nutrition.

Statements made in the press and from

the platform may have given most of us the impression that the country is faced with a deficit of only ten per cent.; but this small deficit, we believe, refers only to that of cereals for whose supply we have been depending mostly upon dollar countries. The import of this important item of our diet has caused a severe drain on our dollar resources which, under normal conditions, should have been utilised for the building up of our industries. If only these imports could be stopped by making the country self sufficient with regard to cereals, the country can take up its programme of industrialisation. The stirring appeal made by our Prime Minister, Pandit Nehru, to the Nation in this connection should evoke an instant and spontaneous response from the heart of every citizen of India. He announced that the Government of India had decided to deal with the food problem on a war basis. "In the mighty drive for food production, which is ultimately a war against poverty and ignorance, against malnutrition and high prices," declared the Prime Minister, "every citizen can be a soldier and can

serve his or her country. All of us will have to tighten our belts."

Panditji outlined a three point programme for abolishing the 10 per cent. deficit :—

1. An intensive and better cultivation of the land, which should result in a 15 per cent. increase of yield ;
2. the growing of supplementary foodstuffs like sweet potatoes, tapioca and banana; and
3. bringing under cultivation lands in the compounds of the houses in towns and cities.

We are all aware of the way in which England mobilised, during its fateful days of German blockade, its resources, every square inch of its land being exploited for food production.

The Central Government will extend all facilities and help to each and every participant in this great and patriotic endeavour and with a view to reduce the red tape and secure quick action and efficient co-ordination, some of the important suggestions of Lord Boyd Orr have been accepted. First, an administrative machinery which can function swiftly and efficiently without the normal delays of the

Government apparatus will be set up. Secondly, perfect and smooth co-ordination and co-operation between the Centre and the Provinces and the States will be secured, and thirdly the organisers "must reach down to the farmer in the field". That is, there must be a closely knit series of links between the high level policy-makers and the farmers to whom belongs the ultimate responsibility of carrying out the policy. The farmer must understand and must willingly co-operate.

It would not be difficult to reach the target set by the Prime Minister by 1951 provided the Government machinery which has to organise this food drive is staffed with conscientious, efficient and competent personnel ; the people in general also have a compelling responsibility in this venture. During the World War II, England launched the "Dig for Victory" campaign which inspired the creation of Great Britain's land army who stepped up the production of food by 25 per cent. Let us "dig for self-sufficiency", and attain the target by 1951.

EDWARD JENNER, 1749-1823

1949 marks the Bicentenary of the birth of Edward Jenner—the Father of Vaccination.

Edward Jenner, born on May 17, 1749, at Berkeley, England, studied Pharmacy and Surgery and started his career as the House Pupil of the great Anatomist, John Hunter. In 1771, Jenner was assigned with the task of arranging Captain Cook's Natural History collections. He did this with such skill and success that Cook invited Jenner to join his next expedition. Jenner refused.

Jenner's epoch-making discovery of Vaccination came in 1796. It was the culmination of the careful experimentation and sound reasoning of Jenner who, to begin with, sought to verify the popular belief that cow-pox gave protection against Smallpox. It is an odd fact that the Royal Society rejected Jenner's findings although he was, by then, already a Fellow elected for his paper on "The Natural History of the Cuckoo". Undaunted by this rebuff, Jenner carried on his work and published his classical paper

entitled "*An Inquiry into the causes and effects of the Variolæ Vaccinæ*".

The importance and value of Jenner's work soon became evident and country after country adopted Vaccination as a preventive means against Smallpox. The first vaccination in India was done in Bombay in 1802. Jenner died in 1823 full of years and honours.

This in brief was the life and work of one of the great benefactors of humanity. And a grateful posterity will cherish Jenner's memory not merely for the protection he gave against a dreaded scourge, Smallpox, but for having kindled the trails of a new science—Immuno-therapy. Pasteur and Koch glowed the torch first lit by Jenner.

Like all truly great men, Jenner was unspoilt by his success and remained to the end what he always loved to be—a quiet country doctor, kindly and affable, fond of music, gentle but firm in his convictions, a lover of nature and above all, devoted to his work.

V. N. K.

THE INDIAN INSTITUTE OF SCIENCE AND THE EGERTON COMMITTEE
REPORT

DEAR SIR,

Please permit me as an "Old Boy" of the Institute to offer you my sincere congratulations for your masterly review of the working of the Institute and suggestions for its improvement. Focussing public and Governmental attention on the Institute is not merely timely, but national interest demands that nothing should be left undone to preserve the unique character of the institution as a centre of research and scientific activities. It has already contributed scientific personnel who hold positions of importance in Universities, Industries and Government organisations throughout India. In spite of many defects the Institute still occupies a prominent, if not the premier, position in the country as regards scientific activity. You have drawn attention to the lack of a well-defined policy as repeatedly pointed out by the four Reviewing Committees, and have commendably avoided controversial matters. One cannot help feeling that the Government of India must share part of the responsibility for the prevalent unsatisfactory state of affairs by taking away (I won't say 'enticing away') for example, the Director at a time when the Institute was at its lowest ebb in the matter of staff. It almost amounts to criminal negligence that the authorities have allowed several departments to run and students admitted without making adequate provision for teaching. A large number of professorial chairs are still without occupants, and this has been going on for several years. Is it too much to hope that the Governing Body and the Government of India at least now will take immediate steps to consolidate the existing departments before adding new ones?

The practice of *inviting* applications for the posts of Director and Professors seems to be *infra dig.* These should be *offered* to eminent men who should consider it an honour to serve the Institute. The terms of appointment should be sufficiently elastic and free from red tape. It is better that a few mistakes are committed rather

than that good work is hampered by red tape. In this connection it is pertinent to recall the illuminating remarks made by His Excellency Sri. Rajagopalachari, the Governor-General of India, in the course of his Convocation Address to the Delhi University, which he delivered early this year (15-1-49). His Excellency declared:

"Where, in accordance with democratic ideas, we have adopted the procedure of election for filling positions requiring expert qualifications, to which appointments were made in the old days by authority, it is necessary to create an atmosphere which would attract the offer of such services by the most capable and high minded among us. We have seen how those who are best qualified to serve in civic administration stand aside, disliking the vexations attendant on election procedure and leaving third and fourth rate men to manage the affairs of local bodies as best as they can. The same fate should not be allowed to overtake our universities. I hope that these remarks of mine, which deal with a matter of very great and growing importance in many of our affairs, will be understood in the spirit in which I have uttered them."

As an "Old Boy" may I also suggest the filling up of a gap in the Institute? This is the provision of a Guest House for the use of vacation and short time workers. I have in mind the example of the Marine Biological Laboratory at Woods Hole. A number of people especially from the Universities would like to spend their vacations more profitably by taking advantage of the facilities which the Institute can easily provide. They could consult the library, attend short summer course lectures, or scientific discussions arranged by the different departments and even carry out some valuable work which cannot be done in their own institutions.

Yours faithfully,

Lucknow University,
July 7, 1949.

M. R. NAYAR.

THE THEORY OF THE CHRISTIANSEN EXPERIMENT

WHEN an isotropic solid, e.g., glass, is powdered and placed inside a flat-sided cell which is then filled with a liquid with a refractive index equal to that of the powder for some wavelength λ_0 in the spectrum, beautiful chromatic effects are observed. This phenomenon is the well-known Christiansen effect and is made use of for making filters. The cell becomes transparent for a restricted region of the spectrum in the vicinity of λ_0 , while the rest of the incident light appears as a halo surrounding the light source. The range of wavelengths regularly transmitted by the cell diminishes as its thickness is increased and is also influenced by other conditions of the experiment. Although many papers have been published both on the experimental and theoretical aspects of the Christiansen filter, there appears to be no recognition of the fact that the behaviour of such a filter should be determined by the principles of wave-optics. Sir C. V. Raman has considered the subject afresh and has shown that the effects exhibited by a Christiansen filter can only be explained in terms of wave-optics.

The basic concepts underlying the new approach to the problem are the following:— The powder—liquid mixture contained in a Christiansen cell is an optically heterogeneous medium, and its functioning depends on the fact that while this heterogeneity vanishes for λ_0 for which the two refractive indices (μ_1 of powder and μ_2 of liquid) are identical, it persists for adjoining wavelengths and disturbs the regular wave propagation in their cases. To find the effect of the cell on the passage of the incident light beam, the total thickness of the cell is conceived as divided up into a sufficiently large number of individual layers,

each of which diverts part of the energy of the incident wave-train away from its original path in the form of diffracted waves. The wave-train finally emerging from the cell is that which had its intensity cut down in this manner by the cumulative effect of the successive layers through which it has passed. The diffracted radiations originating at the individual layers and emerging from the cell give rise to the halo observed in the experiment.

Approaching the problem from the point of view indicated above, Sir C. V. Raman has derived the following theoretical formula for the distribution of intensity in the spectrum of the transmitted light, the variables involved being the wavelength of the light λ , the average size of the particles of the powder Δ , the thickness of the cell z , and the difference in the refractive indices of the powder and the liquid for the wavelength under consideration ($\mu_1 - \mu_2$)

$$I = I_0 e^{-k^2 \pi^2 (\mu_1 - \mu_2)^2 z \cdot \Delta^2 / \lambda^2}$$

The characters of the halo observed around the light source are also discussed in terms of the diffraction theory. The Raman theory explains the facts of observation in a very simple manner and gives results in satisfactory accord with the available experimental data. However, the appearance of λ^2 in the above formula has yet to be demonstrated by fresh quantitative data.

R. S. K.

* Abstract of a paper presented by Sir C. V. Raman at the Scientific Meeting of the Indian Academy of Sciences held on the 30th June 1949 at the Indian Institute of Science. The full paper has appeared in the June 1949 issue of the *Proceedings of the Indian Academy of Sciences*.

DR. CHANDRASEKHAR

THE Russell Lecture, considered the most important astronomical lecture in the Americas, was delivered in Ottawa on June 21st by Dr. S. Chandrasekhar of Yerkes Observatory, Wisconsin. The lecture was one of the highlights of the 81st meeting of the American Astronomical Society, held

in Ottawa, and invitation to deliver it is regarded as the highest honour this Society can bestow. Dr. Chandrasekhar is recognised as one of the world's leading authorities on mathematical physics. The subject of the lecture was "Turbulence—A Physical Theory of Astrophysical Interest".

CHEMOTHERAPY OF TUBERCULOSIS

C. V. DELIWALA, K. GANAPATHI AND S. RAJAGOPALAN

(Department of Chemotherapy, Haflkine Institute, Parel, Bombay)

INTRODUCTION

BEFORE the advent of modern chemotherapy, attempts have been made to cure tuberculosis with drugs without any success. The spectacular results obtained by Ehrlich with salvarsan aroused the optimism that this method could be extended to discover specifics for all infectious diseases. Thus, in the attempts to cure tuberculosis, innumerable compounds of diverse structures and groups, such as those derived from gold, silver, copper, mercury, cadmium and several other rare elements, calcium, arsenic, dyestuffs belonging to various groups, chaulmoogric acid and other related acid derivatives, etc., have been tried with disappointing results. The therapeutic effects obtained with even the best among them, *viz.*, the compounds of gold¹ do not stand comparison with those of Ehrlich. This lack of success with the bacterial infections as contrasted with the achievements with the protozoal infections such as trypanosomiasis and malaria, resulted in a sweeping rationalisation that chemotherapy cannot serve as a weapon for the conquest of the bacterial diseases.

However, the recent brilliant era in chemotherapy initiated by the discovery of prontosil, first dispelled the pessimism by providing spectacular cures against a number of deadly bacterial infections, the results obtained this time even eclipsing those of Ehrlich. The further developments in the subject from the practical and theoretical sides are now a common place. Researches on the wake of sulphanilamide forked out into two important directions. On the one hand, more and more powerful drugs were discovered, while on the other, the efficacy of these drugs in a large number of diseases was assessed. When it was recognised that the spectrum of antibacterial activity of the sulpha drugs was actually spreading out instead of the drugs remaining highly specific for just one infection, it was but natural to think of the sulpha drugs as suitable agents for destroying the tubercle bacilli and thus providing cures for tuberculosis.

SULPHANILAMIDE AND DERIVATIVES

Attempts at the synthesis and trial of derivatives of sulphanilamide as possible

cures for tuberculosis were started by 1938.² Rich and Follis³ reported that sulphanilamide, administered in quantities almost bordering on the toxic dose, was able to arrest the progress of tuberculosis induced in guinea pigs if the treatment was started simultaneously with the infection. Buttle and Parish⁴ found that sulphanilamide appeared to produce some degree of inhibition of an infection in guinea pigs with a human strain of tubercle bacillus; but the drug had little effect on the course of infection in guinea pigs and none in rabbits when a bovine strain was used. Sulphathiazole was found by Ballon, Guernon and Simon⁵ to exert bacteriostatic action on virulent human strains of tubercle bacilli on solid media and to arrest the development of experimental tuberculosis in guinea pigs. Following these reports, a number of investigators have tried many derivatives in experimental tuberculosis but the results are inconclusive; some⁶ have reported favourable effect if the drugs were administered in high doses, while others⁷ could not confirm this. Zucker, Pinner and Heyman⁸ tried sulphanilamide clinically on 13 patients giving the drug by the intravenous drip method maintaining a blood concentration of 17 to 32 mg. per cent. for 5 days at a time with no significant results. So far, no sulpha drug has established itself to be of any value in the management of tuberculosis.

LIPOPHILIC DERIVATIVES OF SULPHANILAMIDES

A number of fatty and other acid derivatives of sulpha drugs have been synthesised and tried on the basis of the heuristic hypothesis that the resistance of the tubercle bacilli to chemicals is possibly due to its protective fatty and waxy capsule and so any chemical with an inherent activity against the tubercle bacilli has a good chance in practice of killing the bacilli only if it could destroy or penetrate through the waxy capsule. This action on the waxy capsule is believed to be conferred on a compound possessing the fatty acid residue by virtue of its physical or "quasiphysical" properties.⁹ Thus, Bergman, *et al.*¹⁰ prepared lipophilic naphthalene derivatives by condensing 4-benzeneazo-1-naphthyl-

amine and 1-benzeneazo-2-naphthylamine respectively, with long chain acyl chlorides; in preliminary trials, some of them were definitely, though slightly, effective in experimental tuberculosis in guinea pigs and in experimental leprosy in Syrian hamsters. Bergman and Haskelberg¹¹ extended this work and have prepared a series of N⁴-acyl derivatives of sulphanilamide which have not been tested in experimental infections. Crossley, *et al.*¹² prepared a series of acyl derivatives of sulphanilamide; of these, N¹-dodecanoyl-sulphanilamide was reported to be very effective in experimental tuberculosis in guinea pigs.¹³ This claim has, however, not been confirmed by a number of other workers.¹⁴ Rajagopalan¹⁵ has synthesised a series of N⁴-acyl and N¹:N⁴-diacyl derivatives of a number of sulphanilamides of established value in other bacterial infections. Wagner-Jauregg¹⁶ prepared N⁴-chaulmoogrylsulphanilamide and has reported this compound to have no curative action either in leprosy in rats or tuberculosis in guinea pigs. The isomeric N¹-chaulmoogrylsulphanilamide is reported to be equal to sulphanilamide in efficacy in experimental streptococcal infections.¹⁷ Arnold¹⁸ has synthesised many 2-sulphanilamidothiadiazoles with higher alkyl substituents in position 5 of the thiadiazole ring; these compounds are easily lipoid soluble but so far none appears to have been tried in tuberculosis or leprosy clinically.

SULPHONE DERIVATIVES

In the history of the chemotherapy of tuberculosis, it is only in 1940, that compounds (derivatives of 4-aminophenylsulphone) were found which were able to arrest definitely experimental tuberculosis in guinea pigs. Rist, Bloch and Hamon¹⁹ found 4:4'-diaminodiphenylsulphone to be far more effective than sulphanilamide against avian tubercle bacilli infections in rabbits. In a detailed study with this compound in experimental tuberculosis in guinea pigs lasting 8 months, Feldman, Hinshaw and Moses²⁰ found that 71% of the untreated controls died of tuberculosis, while only 29% of the treated animals died, part of even this mortality being due to the toxic effects of the drug administered. The high degree of toxicity of this compound made its clinical use as such undesirable. However, it was found that the protecting of

the amino group was a good method of masking the acute toxicity of the parent compound, at the same time making available a steady supply of the parent compound *in vivo* by hydrolysis. Of the many possible derivatives tried, three (promin, diasone and a phosphorylated compound) were found to be less toxic and of these the first two have been extensively tried in tuberculosis.

Promin (sodium 4:4'-diaminodiphenylsulphone-N:N'-didextrose sulphonate), though found to be far inferior to 4:4'-diaminodiphenylsulphone in its bacteriostatic action *in vitro*²⁰ for reasons explained above, has been found by Feldman, *et al.*²¹ to modify the course of infection and favour healing of tuberculosis in guinea pigs (*cf.* also Steekon, *et al.*²²). Promin has been tried clinically in pulmonary tuberculosis but it did not produce as good results as in the animal experiments. Diasone (sodium 4:4'-diaminodiphenylsulphone bisformaldehyde sulfoxylate) was found by Callowman²³ to be the most effective of the compounds tried in experimental tuberculosis in guinea pigs and also less toxic than the other sulphones. Feldman *et al.*²⁴ have confirmed these findings and produced more convincing evidence of the therapeutic value of diasone in experimental tuberculosis. As a result of this, a great deal was expected of diasone in the clinics. The controlled clinical trials with this drug have shown that this drug has not lived upto the expectations.

At this time, the heterocyclic derivative, promizole (4,2'-diaminophenyl-5'-thiazolylsulphone) was introduced as superior to diasone. Feldman, *et al.*²⁵ found this drug to be well tolerated and got very good results in experimental tuberculosis in guinea pigs. This drug was also tried by Feldman clinically. It is doubtful if it has been found to be better than the other sulphones. Just now, the interest in the sulphones was diverted to other channels.

Youmans and Doub²⁶ have tested the action of fifty-nine sulphone derivatives *in vitro* against virulent H 37 Rv strain of *M. tuberculosis*. These compounds comprise derivatives of 4-aminodiphenylsulphone and 4-aminophenylsulphone with a substituted heterocyclic ring. Only a few compounds came out showing activity comparable to 4:4'-diaminodiphenylsulphone. To check whether the *in vitro* method of testing is reliable as a short-

cut screening method to sieve out inactive compounds, Youmans, Feldman and Doub²⁷ have compared the effects of 33 compounds for activity *in vivo* and *in vitro*, the former tests being carried out in guinea pigs. The results have shown a fairly good correlation between the two methods so that we can take the *in vitro* tests as reliable for screening large number of compounds to have a qualitative idea of their activities.

Though the sulphones gave for the first time striking results in experimental tuberculosis in guinea pigs, the results obtained in the clinics are frankly disappointing. No significant advance was made in the practical side, though a fillip has been given to pursue the studies further.

STREPTOMYCIN AND THE ANTIBIOTICS

When the enthusiasm for the sulphones was dying down as a result of the clinical trials, streptomycin entered the scene with a great deal of partiality in its favour because of the spectacular performance of the other antibiotic, penicillin. Streptomycin gave such impressive results in experimental tuberculosis in guinea pigs²⁸ that it was hailed to be the long sought for specific for the conquest of tuberculosis. A number of reports on the action of streptomycin have been published, the most authoritative one being that of the Medical Research Council.²⁹ While no doubt streptomycin is probably the first drug to show very definite curative effect in tuberculosis, its use is limited. It has been found to be of value in acute and exudative cases of tuberculosis wherein the cavity has not developed, while it is of doubtful value in older cases. More extensive trials under controlled conditions will enable us to understand the merits and limitations of streptomycin therapy.

The puzzling feature about streptomycin, which greatly restricts its use, is the fact that *M. tuberculosis* exist (or develop?) which are not only resistant to streptomycin but also requiring streptomycin.³⁰ Those cases harbouring the organisms sensitive to streptomycin give good results by treatment for about two months. Where the resistant organisms predominate as a result of killing of the sensitive ones, the treatment with streptomycin only worsens the case. Since the percentage of the organisms resistant to or requiring streptomycin is only a small fraction, by combining streptomycin with another drug which can tackle the resistant and the "requiring" organisms,

we can hope to obtain very encouraging results. The value of streptomycin in tuberculosis can be appreciated only against the background of the previous consistently disappointing results obtained, in which state of hopelessness even the gold compounds were taken to be cures.

The example of streptomycin has led to the search for other antibiotics. So far none has entered the stage of clinical trials.

PARA-AMINOSALICYLIC ACID

When the mind is being prepared to accept as a dogma that the antibiotics are more likely to provide cures (and also give clues to synthetical investigations by suggesting possible structures), there is a swing back to the syntheticals by the discovery of the striking activity of such a simple compound as para-aminosalicylic acid. This compound was discovered by Lehman³¹ as a result of testing 60 compounds *in vitro* as a possible antagonist of salicylic acid which stimulates the respiration of the tubercle bacilli. The original claims of Lehman have been confirmed³² and this drug is being tried clinically. The past experience with clinical trials with compounds in tuberculosis urges a great deal of caution in giving out any pronouncement at this stage. But it is definite that the discovery of the therapeutic effect of this compound gives a very good lead to search systematically for possible cures even among compounds of simple structures.

FALLACIES ABOUT THE RESULTS IN ANIMAL EXPERIMENTS

A critical review of the literature of the chemotherapy of tuberculosis and particularly those published during the last ten years shows that the enthusiasm created by the animal experiments being damped by the actual clinical trials is a regular feature. There are many important reasons for this. In the first place, as far as the laboratory experiments are concerned, we did not have standardised techniques of animal experiments worked out yielding consistent results that could easily, without fallacy, be extrapolated to the human level. Secondly, the significance of the animal experiments as the index of their value in human tuberculosis in the various stages of the disease, was not fully appreciated and there was a hasty rush to report apparently favourable results. Lastly, the testing of the drugs clinically in such a chronic in-

fection which presents diverse pathological pictures and the results being influenced by a number of factors ranging from psychological to nutritional is so time-consuming and tedious that it is difficult to realise and rectify the mistakes at an early date. This slows down the tempo of research also. Since it takes a long time to accumulate enough clinical data of significance to prove or disprove a claim, there is ample chance for any prejudice or favourite opinion to gain a strong foothold and misguide both the scientific workers and others. The case of the gold compounds is a good example for this.

In recent years, the methods of experimentation have improved. We are now convinced that a drug acts mainly on the parasite and it is axiomatic that the drug should act on the parasite *in vitro* if it is to be of value as a chemotherapeutic agent. Because of the slow rate of growth of the tubercle bacilli and that too in clumps even the *in vitro* methods of testing of the activity of a compound as conducted previously did not yield reproducible results. The new methods now developed in which a new medium and the human strain can be used,³³ have vastly improved the position and is capable of yielding reproducible results in much shorter time. Thus, the initial screening method has speeded up the progress.

The animal experimentation technique using guinea pigs and the human strains of tubercle bacilli, is now well standardised. The method worked out by Dubos using white mice should indeed be a boon, if it is found to give reliable results. The results obtained with the sulphones in experimental tuberculosis is indeed suggestive of definite therapeutic action. But even in these cases, the results obtained correspondingly in the clinics are frankly disappointing. According to the principle of chemotherapy, the ideal conduct of the animal experiments should be such that animal infection should simulate the course of the disease in human beings as close as possible so that the results obtained in the former could be taken as an indication of what we can anticipate in the clinics. In many cases, particularly in the very acute infections such as those due to streptococci, pneumococci, meningococci, etc., the course of the infection in the infected animals (mice) and the human beings are not at all similar.

Still, the results of the animal experiments and those obtained clinically remarkably correspond in these cases; what appears to be of significance in deciding the clinical result is the fate of the parasite in its encounter with the drug in the system (of the animal or human beings). If a difference exists in the pathological picture of the experimental animal and the diseased human beings, or the drug undergoes different courses or degrees of absorption or metabolism in the two, then we should expect concrete difference between the animal experiments and the clinical results. In the case of tuberculosis in the guinea pigs, wherein the course of the disease is not as chronic and the pathological picture also not as complicated as that of the human being, the drug, if it possesses an inherent action on the tubercle bacilli, will have a good chance to encounter the bacilli and destroy them. Thus the drugs that show protective action in the experimental tuberculosis in guinea pigs no doubt indicate an inherent good action of the drug and satisfied an important requirement. The failure in the case of human tuberculosis, particularly in advanced cases, is probably because the drug has not been given a chance to encounter the bacilli; the devascularised character of the tubercular foci with the caseous area constituting the barrier zone between the circulating blood and the tubercle bacilli is responsible for this. So a drug to be useful clinically should also possess the property to approach and penetrate through the tubercle. Or else, the inherent tuberculostatic or tuberculocidal properties of the drug, however powerful it may be, will be of no use in actual practice. Such compounds can be used only in those cases wherein it could easily and directly be brought into contact with the bacilli, in such cases as tubercular meningitis, empyema, etc.

The pathological features of tuberculosis in human beings has thus presented chemotherapy with a very difficult problem. Since chemotherapy is concerned with the direct attack on the parasite, the only way it can solve the problem is by providing a drug which could eliminate completely from the system all the tubercle bacilli, whether free in the tissues or fortified within the devascularised foci, allowing the damaged areas freed from the parasite to recover with the aid of the body defence

forces. These conditions referring to the conduct of the drug in the system, extend the number of specifications of a good drug in addition to the inherent action on the bacteria. Since the drugs in the case of tuberculosis have to be administered over an extended period of time, the question of chronic toxicity is also of vital concern.

Only when all the above have been taken into consideration, one can appreciate why the advance in the case of tuberculosis is not as rapid as in the other acute diseases. The results so far obtained have given us definite leads enabling a rational attack of the problem. While we cannot possibly eliminate the sanatorium or the surgical treatments, we can hope to effectively supplement these established methods.

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Note.—The cost of printing this contribution has been defrayed by a generous grant from the National Institute of Sciences, India,—*Ed.*

1851 EXHIBITION SCHOLARSHIP

THE Royal Commissioners for the Exhibition of 1851 (London) have appointed Mr. K. G. Ramanathan to the Science Research Scholarship offered to India this year. Mr. Ramanathan is at present Lecturer in the Physics Department of the Indian Institute of Science, Bangalore. Of the 10 Scholarships so far awarded to India by the

Royal Commission, four have been secured by students of Sir C. V. Raman working in the Physics Department of the Indian Institute of Science. They are Prof. N. S. Nagendranath (1937), Prof. R. S. Krishnan (1938), Dr. G. N. Ramachandran (1946), and Mr. K. G. Ramanathan (1949).

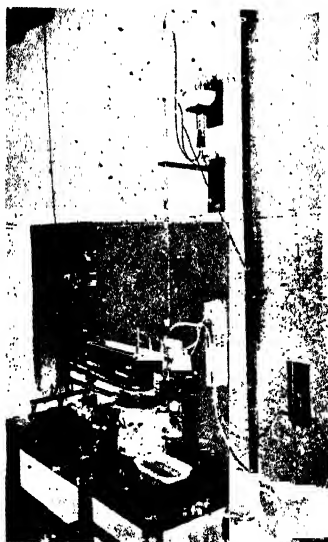
AN APPARATUS FOR THE CORONARY PERFUSION OF THE MAMMALIAN HEART

K. N. GOVINDAN NAYAR

(*Department of Physiology, Madras Veterinary College*)

THE heart removed from the body and kept working is a fundamental experimental preparation used in the study of the role of various factors in the activity of the organ. The technique of doing this with the mammalian heart is not simple. The myocardium of the working heart must be well supplied with nutrient perfusing fluid, which should be well oxygenated and this should be made to circulate through the coronary vessels by maintaining sufficient hydrostatic pressure inside the aorta. The perfusate must also be at about the body temperature of the mammal.

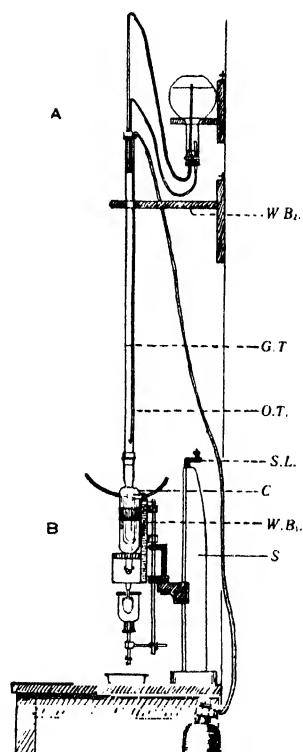
To satisfy the above conditions as regards the oxygen supply, the temperature and the hydrostatic pressure, many forms of apparatus have been designed. The one designed by Gunn¹ is generally used. Harris¹ describes a simpler apparatus which can be constructed in the Laboratory. A very satisfactory one is the Varad-Pillai apparatus. Messrs. Palmer & Co., Ltd., list in their catalogue another type of assembly.²



Basically the principles involved are simple, but in actual working the simpler types present many difficulties. Satisfactory assemblies using complicated

components on the other hand are not easily available and are costly.

Described below is a comparatively simple form of assembly designed and built in this Department out of components usually available in a Physiological Laboratory. It can be built by anyone who is a bit handy with the ordinary laboratory tools. In working it has been found to be very satisfactory.



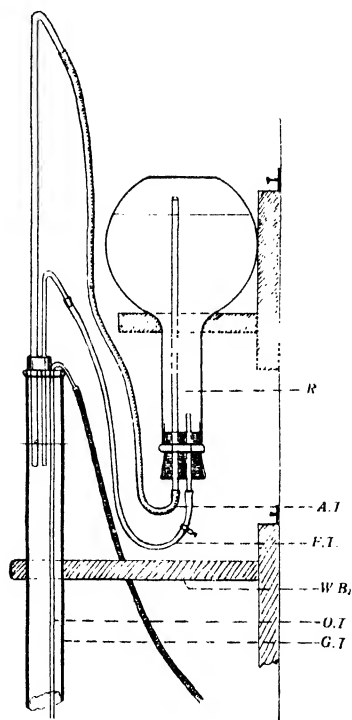
EXPLANATION OF FIG. 1

C., Condenser; G. T., glass tube 40" x 3/4"; O.T., Oxygen tube; S., stand with the screw lift; S.L. screw lift; W.B₁, wooden board carrying the condenser; W.B₂, wooden board holding long glass tube.

The apparatus is assembled on a heavy stand with a screw lift, but can also be mounted on an ordinary stand screwed down to the table. The special screw stand however is very convenient in raising and

lowering the apparatus to take the tracing in any place on the smoked paper on the Kymograph. A wooden board 11" × 3½" is attached to the upright by two screws fixed to its back and clamped into two cross-blocks on the stand. On the board is fixed a good double surface condenser, 8" × 2" by a clamp and support. The outlet tube of the condenser is cut short and by its side is fixed a glass T-tube as shown, one of its limbs carrying a thermometer, another connected to the aortic canula and the third to the outlet of the condenser by a rubber tube carrying a pinchcock. The inlet of the condenser is connected to a long glass tube 40" long and ¾" internal diameter, by a one-holed rubber cork. This glass tube is held in position by being passed through a hole in a wooden board fixed to the wall at the proper height. The tube fits loosely into this hole.

The nutrient fluid is kept at a constant level in this tube by a simple arrangement the details of which are clearly shown in Fig. 2.



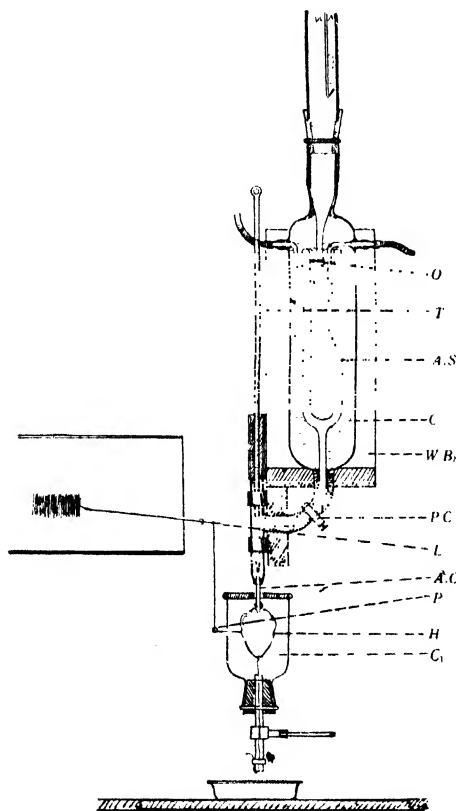
EXPLANATION OF FIG. 2

A.T. Air tube to reservoir; F.T. Fluid tube from reservoir; G.T., glass tube 40" × ¾"; O.T., oxygen tube; R. Reservoir (inverted 2 L. flask); W.B., wooden board,

A long thin tube ending in a fine curved nozzle reaches to the bottom of the column in the upright tube. A steady stream of small bubbles of oxygen is maintained and this ensures efficient oxygenation of the perfusate.

The temperature of the perfusate is controlled by circulating warm water through the jacket of the condenser. Cold water from the tap is warmed by passing through a copper jacket enclosing a 1000 W. immersion heater. The temperature can be easily controlled by adjusting the flow of water.

The heart after being attached to the canula is enclosed in a cover with a hole at its side, made from a bottle by removing its bottom. The arrangement of the lever, etc., follow the usual lines and the details are shown in Fig. 3.



EXPLANATION OF FIG. 3

A.C. Aortic canula; A.S. Annular space of the condenser; C. condenser; C1. cover for the heart; H. The heart; L. Lever; O. Opening of the inlet of the condenser into the annular space; P. Pulley (½" vulcanite); P.C. Pinch-cock; T. Thermometer; W.B., Wooden board.

Mention may be made of the following features of this assembly.

1. Hydrostatic pressure in the aorta is kept constant irrespective of the level of the nutrient fluid in the reservoir.

2. The temperature remains steady and can be easily controlled.

3. The effects of various drugs, etc., on the heart can be studied by injecting them into the rubber tube connecting the outlet of the condenser to the T-tube through a thin hypodermic needle without disturbing the heart and introducing any irregularity in the tracing. For continuous perfusion with any solution other than the one in the

reservoir, the reservoir can be quickly replaced by another containing the solution.

An assembly similar to the one described here has been in use in this Department for three years now and has been found to be convenient. This description is published at the instance of the Principal, Sri. S. V. Mudaliar, G.M.V.C., to whom the author is indebted for every encouragement.

1. "Experimental Physiology" D. T. Harris.
2. Catalogue of Messrs. Palmers Co. Ltd., London.

Note.—The cost of printing this article has been defrayed by a generous grant from the National Institute of Sciences, India, —*E.L.*

HONEY HUNTING*

SWARMS of bees pass overhead on any warm day in the Spring like a rapidly-moving smoke cloud that soon disappears into the distant forest. Swarms also form dense clusters two or three feet long on the branches of trees. Where they come from and where they go form a fascinating study.

Bees establish themselves in hollows of tree trunks and branches and continue to nest there for years. Each year when the nest or the hollow becomes too crowded and when there is not enough space for the bees to store a sufficient amount of honey to sustain the colony through the winter months, the bees provide a new queen for themselves by constructing large, more or less cylindrical, "royal cells". The grub that develops from the egg laid in such a cell is provided with "royal jelly", a special food secreted by the worker bees and fed to the bee that is to develop into a queen. When this new queen emerges, the old queen and part of the swarm leave their nest to seek a new home in the cavity of another tree, leaving the old home to the new queen and the brood she will produce.

Wild bee hunting has been a popular autumn sport in some parts of U.S.A. and gives the hunters the same thrill that fishermen derive. Several methods are used in locating the forest homes of wild bees but probably the most popular is the use of the bee-box. This is simply a wooden box approximately the size of a cigar box fitted with a glass top that slides in grooves. A hole about one inch in diameter is made in one end through which the bees can enter and leave. A slide is fashioned so that the hole may be closed if the hunter wishes to imprison the bees for a short time. An old piece of honeycomb about 4×6 inches com-

pletes the outfit. The bait to attract the bees is honey or sugar syrup, which is poured into the cells of the comb. On a warm autumn day when the frosts have stopped the honey flow, and the bees can easily be attracted to the bait, the box is set up on a stump or stand in a field near the woods. Now a piece of comb is burned or a few drops of oil of anise are poured on the stump to attract the bees. A few bees appear in a few minutes and take a drink from the comb, and fly back to their home in a "bee line". Next, the box is moved 200 or 300 yards to one side and another "bee-line" is obtained. The tree which is their home is located where the two lines cross. The home may be a tree, or a farmer's hive. Wild bees make their homes in the most unexpected places. A chimney or pipe of a gas-well derrick, the samson post of an oil well or an abandoned box-trap once used to catch rabbits, will house the bee nest.

Bee-hunters tap from 40-100 pounds of honey from the nests. The quality and type of wild honey vary considerably according to location, climate and the number of years the bees have occupied a tree cavity. The honey is usually strained from the combs, by placing them in a muslin bag and hanging it above the kitchen stove. The heat melts the wax capping of the cells and the honey drips through the bags. The bees wax is also preserved.

The cutting of bee-trees should be discouraged since bees are so essential to the fertilisation of our agricultural and forest, fruit and vegetable crops.

* Abstract of an article on "To Find Wild Honey", by Arthur C. Parsons. Grateful acknowledgements to *Natural History*, 1949, 58, No. 4.

LETTERS TO THE EDITOR

	PAGE		PAGE
Some Conjectures in Number Theory— HANSRAJ GUPTA	241	The Effect of Cocoanut Water on the Growth of Immature Embryos of Corn (Maize)—P. UTTAMAN	251
Relative Effects of Carbon Dioxide, Tem- perature and Light Intensity upon Photosynthesis—K. N. LAL	241	Preliminary Note on the Heteroecism of] Puccinia versicolor—M. J. THIRUMALA- CHAR AND M. J. NARASIMHAN	252
On the Power Function of the Test for the Compatibility of an Assigned Discrimi- nant Function—R. D. NARAIN	243	Inheritance of Petal-Base Colour in Lily's Finger, Hibiscus esculentus Linn.—R. H. RICHHARIA	253
Natural Gas at Jawalamukhi Mandir— MOHAN LAL KHANNA AND INDER SAIN GUPTA	244	Mutation in Brassica campestris Linn. var. Sarson Prain—G. N. PATHAK AND B. B. SINGH	253
Emission Spectra of the Manganese Halides—P. TIRUVENGANNA RAO	245	On the Occurrence of Cordyceps Spheco- cephala (KL.) Sacc. Near Calcutta— J. SEN	254
The Band Spectrum of TiCl—V. RAMA- KRISHNA RAO	245	Structure and Function of Bursa Copulat- rix and the Associated Organs in Bru- chidae (=Lariidae) [Coleoptera-Phyto- phaga] and Their Taxonomic Signific- ance—S. MUKERJI	255
A Study of the Scattering of Light in Normal Urines—V. F. NARAYANAN NAMBIAR	245	On Spawning Conditions and Larvicidal Propensities of Carassius auratus— P. I. CHACKO AND S. V. GANAPATI	257
Angiospermic Remains from Barmer Sandstones—M. N. BOSE	245	On the Occurrence of Enteropneusts in Shingle Island, Gulf of Manaar—G. K. KURIYAN	258
A Preliminary Note on the Preparation of Zirconium Succinate Jellys S. P. MUSHRAN	247	Sequel to the Hybridization Between the Sugarcane x the Bamboo—T. S. VENKAT- RAMAN	258
Colorimetric Detection and Estimation of Thorium—T. K. S. MURTHY AND BH. S. V. RAGHAVARAO	248	On a Nostochopsis from Mysore—H. C. GOVINDU, B. A. RAZI AND K. M. SAFEULLA	258
Separation of Tetravalent Cerium from Thorium and Other Trivalent Rare Earths—The Use of Potassium Periodate— M. VENKATARAMANIAN AND BH. S. V. RAGHAVARAO	248	Occurrence of Hyaline Trabæcular Cells in the Mesophyll of Derris bentharii— T. ANANDA RAO AND H. C. GOVINDU	260
Tick-Borne Relapsing Fever in Kashmir— K. N. A. RAO AND S. L. KALRA	249	Schizanthus Sp. a Host of Tobacco Leaf- Curl Virus—R. P. GARGA	260
Overall Growth-Promoting Potency of Neera (Unfermented Juice) and Toddy (Fermented Beer) from Phoenix sylvestris—M. R. RAGHAVENDRA RAO AND M. SREENIVASAYA	253	A New Method for the Diazotisation of Amines—A. DIAS, A. N. KOTHARE AND V. V. NADKARNY	261
A New Method for the Estimation of Vitamin C—B. NAGANNA AND P. RAMA- CHANDRA RAO	250		

SOME CONJECTURES IN NUMBER THEORY

THE object of this note is to give some recent conjectures in the Theory of Numbers and what has been done about them.

1. A Conjecture of Miller.

If $\mu(n)$ and $M(n)$ be the well-known Möbius functions, then

$$A(n) = \left\{ \sum_{m=1}^n M(m) \right\} / n \leq 0 \text{ for } n \geq 3.$$

The conjecture was verified by Miller for values of n up to 1000. I now find that the conjecture holds for values of n up to 20000 at least.

2. A Conjecture of Chowla.

If p be a prime of the form $4q + 1$, then the sum of the quadratic residues of p which are less than $p/2$ is less than the sum of the non-residues less than $p/2$.

I have verified Chowla's conjecture for

primes up to 200 and also for the primes 1009 and 1997.

Further, if p be a prime of the form $4q - 1$ then I find that the sum of the quadratic residues of p which are less than p is less than the sum of the quadratic non-residues less than p , $p < 200$.

In fact, if $S(p)$ denote the sum of the quadratic residues specified above, then

$$S(p) \leq (p-1)^2/16 \text{ or } (p-1)^2/4,$$

according as p is of the form $4q + 1$ or $4q - 1$.

Govt. College,
Hoshiarpur,
May 18, 1949.

HANSRAJ GUPTA.

RELATIVE EFFECTS OF CARBON DIOXIDE, TEMPERATURE AND LIGHT INTENSITY UPON PHOTOSYNTHESIS
RESEARCHES in photosynthesis have shown that rate of carbon dioxide absorbed by leaves is related to concentration of this

gas in the atmosphere, temperature, and light intensity prevailing at the time of the experiment. To what extent these external conditions are related to photosynthesis is elucidated in this note.

Sugarcane leaves were gathered during the adolescent stage of the life-cycle. Their rate of photosynthesis was determined under wide ranges of external conditions by the continuous current method using baryta as an absorbent.

In a multi-factorial physiological process like this, the rate of photosynthesis (p) is dependent upon carbon dioxide concentration (c), light intensity (l) and temperature (t). The correlation coefficient (r) between (p) and one of these factors, e.g. (c) represents the relation between these variables. This is evaluated from the equation*:

$$r_{p,c} = \frac{\sum dp \cdot dc}{\sqrt{dp^2 \cdot dc^2}}$$

$$\text{and S.E. } r = \frac{\sqrt{1-r^2}}{\sqrt{n-2}}$$

where r = correlation coefficient;

$\sum dp \cdot dc$ is the sum of products of deviation of p and c from respective means;

dp^2 and dc^2 = S.S. variance due to p and c ;

n = number of samples;

and S.E. = Standard error.

Calculated in this way, the correlation coefficients between carbon dioxide, light and temperature, and photosynthesis are:—

$$r_{lp} = 0.503 \pm 0.18$$

$$r_{tp} = 0.048 \pm 0.21$$

$$r_{cp} = 0.53 \pm 0.18$$

Photosynthesis thus appears to be significantly correlated with both light and carbon dioxide, an increase in the latter two invariably raising the former. Temperature under the conditions of the experiment shows no significant relation at all.

Since the effect of one factor on photosynthesis is so interlinked with that of another, the correlation coefficients thus obtained may be partially or wholly affected by the simultaneous influence of other variables, the effect of which was not under experimentation. To eliminate this, net or partial correlation coefficients between each of the conditioning variables and assimilation rate of leaves are calculated as follows:

$$r_{lp,lc} = \frac{r_{lp} - r_{tp} \cdot r_{cp}}{\sqrt{(1-r_{tp}^2)(1-r_{cp}^2)}}$$

$$r_{cp,lt} = \frac{r_{cp} - r_{lp} \cdot r_{tp}}{\sqrt{(1-r_{lp}^2)(1-r_{tp}^2)}}$$

$$r_{lp,lt} = \frac{r_{lp} - r_{tp} \cdot r_{cp}}{\sqrt{(1-r_{tp}^2)(1-r_{cp}^2)}}$$

Substituting the respective values of r_{lp} , r_{tp} , and r_{cp} in the above equations the net correlation coefficients are found to vary as follows:

$$r_{lp,lc} = +0.67 \text{ (High positive correlation)}$$

$$r_{cp,lt} = +0.59 \text{ (High positive correlation)}$$

$$r_{lp,lt} = -0.40 \text{ (poor negative correlation)}$$

Assuming that the relation between each of the factors and photosynthesis is linear at least under limiting concentrations of carbon dioxide as is usually found in the atmosphere, the next step lay in determining the straightline of best fit to represent the relation between the respective intensities of the factors and assimilation rate of leaves. This was felt all the more necessary in order to predict the rate of photosynthesis under varied conditions of external factors. Line of best fit is drawn by determining the constants a and b , and tracing the relation between p and c in the equation:

$$p = a + bc.$$

The values of the constants a and b are determined after the procedure laid down elsewhere.† These being known, the relationship between the three factors and photosynthesis is mathematically expressed by the equations:

$$p = 5.36 + (-0.079 \times t)$$

$$p = 2.84 + (1.15 \times c)$$

$$p = 1.26 + (0.0015 \times l)$$

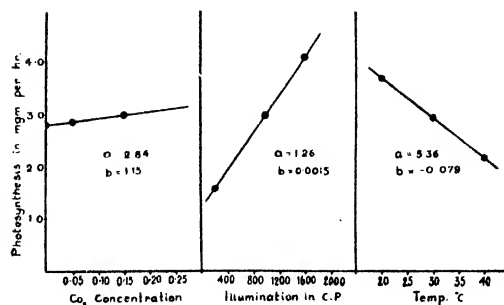


FIG. 1. Straight lines of best fit showing the relation between temperature, light intensity and CO_2 concentration and photosynthetic rate of sugarcane leaves

These equations may be referred to predict the expected intensity of photosynthesis under any specific concentration of the above three factors. The lowest value recorded would indicate this expected rate likely to be obtained under these conditions.

Another method is to draw out the line of best fit as shown in Fig. 1. The respective values of assimilation against the corresponding intensities of the three factors is read out; minimum rate of photosynthesis so obtained is taken to be the

TABLE I

Rate of photosynthesis of mature leaves of sugarcane per 100 sq. cm. per hour in mgm. of carbon dioxide under varied intensities of light, temperature and carbon dioxide

st. No.	Photo-synthesis	CO ₂ %	Light C.P.	Temp. °C
1	0.463	0.020	90	30.10
2	1.050	0.051	90	20.10
3	1.150	0.080	90	30.10
4	1.005	0.128	90	30.10
5	0.960	0.371	90	30.10
6	0.680	0.011	375	30.10
7	2.391	0.121	375	30.10
8	2.510	0.407	375	20.10
9	1.964	0.036	1500	30.10
10	1.480	0.011	1500	30.10
11	6.100	0.124	1500	30.05
12	6.38	0.403	1500	30.10
13	3.303	0.047	1875	30.10
14	6.290	0.124	1875	30.10
15	7.770	0.172	1875	30.10
16	7.920	0.358	1875	30.10
17	1.520	0.052	375	30.00
18	2.100	0.052	1500	30.00
19	2.230	0.051	1875	30.00
20	2.300	0.052	1875	23.00
21	2.82	0.052	1875	30.00
22	3.200	0.052	1875	34.00
23	3.050	0.052	1875	39.00

TABLE II

Observed and calculated rates of assimilation of sugarcane leaves under limiting and non-limiting concentrations of carbon dioxide in air

Experiment No.	Observed rate	Calculated rate
Limiting CO ₂	3	1.15
	17	1.52
	18	2.10
	19	2.23
	20	2.30
Non-limiting CO ₂	21	2.82
	12	6.38
	15	7.77
	16	7.92

nearest approximation to the values that are likely to be obtained under actual experimentation.

From a close scrutiny of the calculated and observed values (Table II) it is obvious that the two approximate very closely under limiting concentrations of carbon dioxide whereas under higher percentages, differences are sufficiently high. For predicting the assimilation rate under atmospheric conditions of carbon dioxide, therefore, lines of best fit of the type drawn out in Fig. 1 are sufficiently helpful and may well be utilised for field investigations on photosynthesis.

Plant Physiol. Laboratory, K. N. LAL.
College of Agriculture,
Benares Hindu University,
Banaras,
February 23, 1949.

* Paterson, *Statistical Technique in Agricultural Research*, McGraw Hill, 1939. Pp. 106.

† Smith, *Agricultural Meteorology*, Macmillan, 1920.

ON THE POWER FUNCTION OF THE TEST FOR THE COMPATIBILITY OF AN ASSIGNED DISCRIMINANT FUNCTION

USES of Hotellings T²-test may be classified into two broad categories, one, which is more familiar, represented by the test of significance of a fitted discriminant function, and the other by the test of compatibility of an assigned discriminant function. A more general problem, illustrated by Rao (1948), which may be grouped under the second category, is to test whether p assigned linear functions may reasonably be supposed to explain the differences between two $p + q$ variate samples. This classification is particularly relevant because, as the present author has shown, the power functions of the tests in the two cases differ. In other words the test criteria while following similar distributions under the null-hypothesis will have different non-null distributions. Following Rao's notation the test criterion for the class of problems under the latter category may be called the U-statistic, T² being reserved for the former category. The non-null T² distribution is already known (Hsu, 1938; Bose & Roy, 1938). The non-null U-distribution has been obtained by

the author as

$$\frac{1}{\Gamma\left(\frac{\nu-p-q+1}{2}\right) \Gamma\left(\frac{\nu-p+1}{2}\right)} e^{-\frac{1}{2}\delta^2} U^{\frac{q-2}{2}} (1+U)^{\frac{\nu-p+1}{2}} \\ \times \sum_{m=0}^{\infty} \sum_{l=0}^{\infty} \left[\frac{\Gamma\left(\frac{\nu-p+1}{2} + m\right) \Gamma\left(\frac{\nu+1}{2} + l\right)}{\Gamma\left(\frac{q}{2} + m\right) \Gamma\left(\frac{p}{2} + l\right) \Gamma(m+1) \Gamma(l+1)} \left(\frac{1}{2}\right)^{m+l} (\delta^2)^l (\Delta^2 - \delta^2)^m \left(\frac{U}{1+U}\right)^m \right] dU \\ \times I\left\{\frac{\Delta^2 - \delta^2}{2}, \frac{\nu-p-1+2m}{2}, \frac{p-2+2l}{2}\right\}$$

where $I(k, a, b) \equiv \int_0^1 e^{-kx} x^a (1-x)^b dx$

In the above distribution δ^2 and Δ^2 are population parameters, the hypothesis under test being $\delta^2 - \Delta^2 = 0$, and ν is the digress of freedom of the sample estimates of the population dispersion matrix.

Details are being published in the *Journal of the Ind. Soc. of Agr. Stat.*

R. D. NARAIN.

Indian Council of Agric. Research,
New Delhi,
March 15, 1949.

1. Hsu, P. L., "Notes on Hotelling's generalised T," *Ann. Math. Stat.*, 1938, 9, 231. 2. Bose, R. C., and Roy, S. N., "Distribution of the studentised D²-statistic," *Sankhya*, 1938, 4, 19. 3. Rao, C. R., "Tests of significance in Multivariate analysis," *Biometrika*, 1948, 35, 58.

NATURAL GAS AT JAWALAMUKHI MANDIR

THE history of the Baku oil-fields¹ in the Caucasus mountains is associated with the fire worshippers, who went there to visit the petroleum flames burning natural gas emitted from the earth. To them it must have appeared a very wonderful and awe-inspiring sight to see a fire fed with invisible fuel and burning from time immemorial.

Inside the famous temple, *Jawalamukhi Mandir*, in *Kangra District*, East Punjab, India, gas is constantly coming out of the soil and is being burnt. Through the year round people from distant places flock to this temple as a place of worship. As the gas does not appear to have been analysed so far, we considered an analysis desirable. Though the gas from inside the temple could not be collected, yet a sample of

this gas was procured from *Tibi Gorakh-nath*, distant a few feet from the temple. Gas was collected in an air-tight glass aspirator over gas-saturated ditch water. It was analysed in these laboratories using a modified Orsat's gas analysis apparatus. Its flame is very poor in luminosity. It showed practically no absorption over fuming sulphuric acid, bromine water and ammoniacal cuprous chloride solutions. The olefines, acetylenes and carbon monoxide, if present in the gas, may be present only in very small quantities. On exploding the residual gas with oxygen, the results of four different experiments showed it to contain a large amount of aliphatic hydrocarbons estimated as methane and a small portion of hydrogen. The composition of the gas corresponds almost to the natural gas coming out of the oil wells.

It is now well known that the Attock Oil Company² has been producing crude oil by drilling at Khaur, 45 miles south-west of Rawalpindi since 1914. Unsuccessful test-wells have been drilled in the Marwat Range, Trans-Indus, on the Sukkur dome, south of Rohri, in Sind and on the Mekran coast near Chandragup. It is most probable that oil occurs in the vicinity of Jawalamukhi Mandir either as a separate oil-field extending from Jammu to the Simla Hills or as an extension of the Indus oil belt.

India is very poor in her internal sources of petrol. Before the partition of the country, crude oil obtained from the oil-fields in Assam and the Punjab was utilized for the production of petrol. With the partition of the country by the creation of Pakistan, the Punjab oil-fields have passed on to the sister dominion and the Indian

Union is left only with the solitary source in Assam, which can meet nearly 10 per cent. of the country's petrol demand. For the rest of her consumption, India to-day has to import the supplies mainly from the neighbouring countries, namely Burma, Iran, Iraq, Bahrein Islands, etc. Recently the Government of India has invited foreign oil experts for consultations to set up oil refineries along the Indian coast and to manufacture synthetic petrol from the existing grades of Indian coals by the well-known Fischer-Tropsch method. It is, therefore, all the more necessary that large-scale oil prospecting in Kangra Valley need to be carried out by the Government of India and a number of oil wells be drilled after successful oil prospecting has been completed by the oil experts.

The authors take this opportunity of thanking Principal Narinjan Singh, Head of the Department of Chemistry, East Punjab University, for procuring us a sample of gas from the temple for analysis. Physical Laboratory, MOHAN LAL KHANNA, C.S.I.R., Delhi, and Chemistry Dept., INDER SAIN GUPTA, East Punjab Uni., Delhi, May 20, 1949.

1. Evans, E. A., "Lubricating and Allied Oils," Chapman and Hall Ltd., London, third edition, 1945, p. 2. 2. Pinfold, E. S., "The Science of Petroleum," Oxford University Press, London, 1938, 1, 138.

EMISSION SPECTRA OF THE MANGANESE HALIDES

IN a previous paper,¹ the author reported a system of bands of MnCl in emission in the region λ 3900- λ 3500. On the analogy of the interpretation of the MnF bands by Rochester and Olsson,² the above system was considered as due to a ${}^1\pi-{}^1\Sigma$ transition. But on account of the complex structure and abnormal intensity distribution among the heads, a transition ${}^7\pi-{}^7\Sigma$ (rather than ${}^7\pi-{}^7\pi$ as considered by Muller³) involving high multiplicity terms was suggested as perhaps more probable. While the analysis on this basis was in progress, Bacher⁴ published a paper on the structure of the Mn halide bands, attributing them to the transition ${}^7\pi-{}^7\Sigma$. In MnCl, Bacher's analysis could be complete only

for the $\Delta v=0$ sequence; the bands are obtained in absorption. The author has since confirmed the scheme and extended it to the remaining sequences $\Delta v=\pm 1, \pm 2, \pm 3$, which he could obtain with a fairly good intensity in emission. A similar analysis of the MnBr bands corresponding to the higher sequence $\Delta v=+1$ is also obtained.

Details of the work have been communicated recently for publication in the *Indian Journal of Physics*.

Andhra University, P. TIRUVENGANNA RAO.
Waltair,
April 5, 1949.

1. Tiruvenganna Rao, *Curr. Sci.*, 1948, 17, 209; —, *Ind. Jour. Phy.* (in press).
2. Rochester and Olsson, *Zeit. f. Physik.*, 1939, 114, 495.
3. Muller, *Helv. Phy. Acta.*, 1943, 16, 1.
4. Bacher, *Ibid.*, 1948, 21, 379.

THE BAND SPECTRUM OF TiCl

IN the course of extensive investigations in our laboratory on the complex band spectra of diatomic molecules notably the halides of the transition group of elements, the band spectrum of TiCl is investigated. A characteristic spectrum is obtained by running a transformer discharge through TiCl vapour. Two systems are photographed in the regions— λ 4209-3702, comprising in all of five groups. The first system was partially analysed by More and Parker. The two systems have a common ground state. The transitions may be ${}^4\pi-{}^4\Sigma$ and ${}^4\Sigma-{}^4\Sigma$ for the less and more refrangible systems respectively. The following are the approximate vibrational constants:

	ω_e'	$x_e'\omega_e'$	ω_e''	$x_e''\omega_e''$
System I	534	1.5	455	3.8
System II	474	4.4	455	3.8

Details of the analysis will be published shortly elsewhere.

V. RAMAKRISHNA RAO.
Department of Physics,
Andhra University,
May 28, 1949.

A STUDY OF THE SCATTERING OF LIGHT IN NORMAL URINES

IN a note¹ in the *Indian Journal of Physics*, S. Ranganathan reported results of depolarisation measurements of light scattered transversely in samples of normal

and pathological urines. Ranganathan's experiments were however confined to a measurement of depolarisation using incident unpolarised light alone. It was thought desirable to undertake a fuller investigation of the problem using incident light in the three states of vibration. With this object in view the present investigation was undertaken.

Upwards of some fifty samples of normal urines were subjected to investigation, the samples selected being such as to cover persons of both sexes and of different ages. The urines were obtained from the Madras Medical College, after being certified as normal.

The depolarisation factors ρ_{μ} , ρ_{τ} , and ρ_{θ} of the light scattered by the urine were measured using incident light, unpolarised, and polarised with the electric vector vertical and horizontal respectively. Sunlight was used as the source of illumination and the measurements were made visually by the Cornu method.²

The following results were obtained:—

(1) In all normal urines the value of ρ_{μ} ranges from 7.5% to 13.0%. The upper limit compares favourably with Ranganathan's value but the lower one is slightly less than his.

(2) The unitary value of ρ_{θ} in all normal urines points clearly to the conclusion that the scattering particles are small ellipsoidal particles, their size being small in relation to the wave-length of light.

(3) The values of ρ_{τ} , which vary from 3.8% to 7.0%, are indicative of the optical anisotropy of the scattering particles.

(4) The factors of depolarisation seem to have no dependence whatever on the age or sex of the person concerned.

Further experiments with different types of pathological urines are in progress. Details will be published elsewhere.

In conclusion the author desires to express his grateful thanks to Dr. A. S. Mannadi Nayar, Surgeon-General with the Govt. of Madras, for his very valuable guidance in the conduct of the present investigation. The author's thanks are also due to Sri. D. V. Rao, Meteorological Officer, Willingdon, and Major Kumaravelu, Asst. Professor of Bio-Chemistry, Madras

Medical College, for their helpful interest in the progress of this work.

V. P. NARAYANAN NAMBIYAR.

Physics Department,
Pachaiyappa's College, Madras,
June 14, 1949.

1. Ranganathan, S., *Ind. Journal of Physics*, 1931, 6, 463. 2. Krishnan, R. S., *Proc. Ind. Acad. Sci., A*, 1935, 1, 915-27.

ANGIOSPERMIC REMAINS FROM BARMER SANDSTONES

ON the 24th January 1948 Mr. S. K. Borooah, Director, Department of Mines and Geology, Jodhpur State, sent the late Prof. B. Sahni a sample of 'Barmer Sandstone' containing a leaf impression. The specimen was kindly given to me by Professor Sahni for investigation. It was an incomplete impression of a dicot leaf (Fig. 1) not preserved well enough for identification. In order to search for more fossils from the locality from which the above specimen was collected I myself went to Jodhpur on 24th April 1948. There I met Mr. Borooah who very kindly accompanied me to the fossil locality.

The Barmer Hills are about a mile north west from the town of Barmer (25°40': 71°25'). Near the foot of the hills are situated five wells. Two of these had gone dry and were further excavated to strike water. It was from this recent excavation of one of these dry wells that Mr. Borooah had collected his sample. The well is at a distance of about 125 feet from the foot of the Barmer Hills and its present depth is approximately 110 feet. The lowermost bed of the well is of dark carbonaceous clay. Mr. Borooah and myself split about a hundred pieces of this clay and got four more impressions of dicot leaves, which too were incomplete. These leaves appear to belong to species different from the sample first sent by Mr. Borooah. We also collected a few impressions and incrustations of stems.

The microfossil examination of the matrix bearing the leaf impressions showed very interesting results. Small pieces of these rock specimens were macerated with Schulze's mixture ($\text{HNO}_3 + \text{KClO}_4$). Their examination revealed a large number of angiospermic pollen grains (Figs. 2, 3 & 4) along with a few which appeared to be gymnospermous in nature. There are also present some spores of the tetrahedral type

and a good number of fungal spores most of which are septate. The fungal spores are of all the varieties from unicellular to multicellular. Many of the pollen grains have clearly preserved germ pores (as shown in Figs. 2, 3).

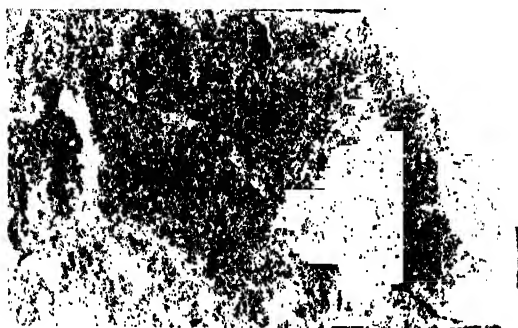


Fig-1

Nat. Size



Fig-2

× 720

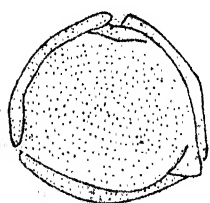


Fig-3

× 1040



Fig-4

× 720

FIG. 1. Impression of a dicot leaf.

FIGS. 2, 3 & 4 Angiospermic pollen grains.

There are two views regarding the age of the Barmer Sandstones. W. T. Blanford (*Rec. Geol. Survey Ind.*, Vol. X, 1876) correlated them with the marine Jurassic beds

of Jaisalmer. T. D. La Touche ("Geology of Western Rajputana", *Mem. Geol. Surv. Ind.* Vol. XXXV, Pt. 1, 1902) thought that as the Barmer Sandstones contained dicot remains they could not be older than the Cretaceous. M. S. Krishnan in his book "Geology of India and Burma," 1943 pp. 252 and 374, mentions that these may be of the same age as the Himatnagar and Umia Sandstones. The age of these rocks is thus still a matter of controversy. The present discovery of definitely angiospermic fossils from the Barmer rocks is of considerable interest because, so far as I know, there is no published description or figures of the dicot remains mentioned by La Touche. Discussion of the age of the Barmer strata in the light of the fossils now found is reserved till the material has been worked out in detail.

Institute of Palaeobotany, M. N. Bose.
Lucknow,
May 18, 1949.

A PRELIMINARY NOTE ON THE PREPARATION OF ZIRCONIUM SUCCINATE JELLIES

ZIRCONIUM succinate has been described by Handl¹ as a white flocculent precipitate obtained on adding sodium succinate to a solution of a zirconium salt. An attempt has now been successfully made in this laboratory to prepare zirconium succinate jellies and this communication describes the preliminary results on the conditions under which they can be obtained.

The jellies have been obtained by the metathetical reactions between a 5% sodium succinate and a 15% zirconium nitrate solution. 2 c.c. of the zirconium nitrate solution are taken in test tubes and varying amounts of the sodium succinate solutions are added. The total volume is kept 6.5 c.c. The mixtures are thoroughly shaken and kept at 30° C. The influence of the varying amounts of sodium succinate on the time of setting of the jellies are recorded.

Amount of sodium succinate (c.c.)	Time of setting (Minutes)
3.9	120
3.7	160
3.5	200
3.3	230
3.1	260
2.9	280
2.7	300

When freshly prepared these jellies are perfectly transparent. They however gradually gain opalescence and finally become opaque when kept for a long time. They are perfectly stable, undergo no syneresis and are thixotropic in nature.

Further work on these jellies is in progress. Grateful thanks of the author are due to Dr. Satya Prakash for his kind interest in this work.

Chemical Laboratories, S. P. MUSHRAN.
The University, Allahabad,
April 30, 1949.

1. Handl, *Jahresbericht uber die Fortschritte der Chemie*, 1859, 279.

COLORIMETRIC DETECTION AND ESTIMATION OF THORIUM

A NUMBER of reagents have been reported for the detection of thorium,¹ but few are specific and interference from rare-earth is a common disadvantage. Germuth and Mitchel reported that sodium alizarinsulphonate (Alizarin-S) yields a red colour with the thorium ion which is neither sensitive nor specific. Details of the conditions in which the investigators arrived at these conclusions are not available. Nevertheless, it has been found that under the conditions detailed below, the reagent provides not only a fairly sensitive test, but may as well be used for the colorimetric estimation of moderate quantities of thorium. As the following data shows, the method may be applied for the rapid assay of monazite for thorium. The reagent is not specific for thorium only as zirconium, titanium, and tetravalent cerium interfere.

EXPERIMENTAL

(a) *Detection*.—The reagent is prepared by dissolving 0.01 gr. of alizarin-S in 100 c.c. of 0.125 N. hydrochloric acid and diluting the solution to one litre. One drop of the reagent gives with one drop of thorium solution, containing not less than 0.01 mg. of the element per c.c., a distinctive pink colouration. Cerite earths to the extent of 3 to 4 mg per c.c. cause no interference.

(b) *Estimation of thorium*: The following data obtained with a simple Dubosq colorimeter represent the average of a number of observations, which in the extreme did not differ by more than 5 per

cent. It has been found that a standard made from 0.4 mg. of thorium and 10 c.c. of the reagent diluted to 20 c.c. gives the best results and thorium in amounts 0.2 to 0.5 mg. may be very conveniently estimated, although at the higher concentrations the results are a little low.

Thorium taken mg.	Cerite earths added mg.	Thorium found mg.	Thorium taken mg.	Cerite earths added mg.	Thorium found mg.
0.20	..	0.212	0.40	..	0.397
0.30	..	0.308	0.40	2.00	0.398
0.30	1.50	0.304	0.40	4.00	0.394
0.30	3.00	0.302	0.45	..	0.440
0.35	..	0.360	0.50	..	0.485
			0.50	2.50	0.484

(c) *Estimation of thorium in monazite.*

A sample of monazite solution from which zirconium has been removed was treated with hydrogen peroxide to remove tetravalent cerium and after boiling to decompose the excess peroxide, the solution was to have a thorium content of 0.08 mg. per c.c. Aliquots of this solution were employed to determine the thorium content and the following results were obtained.

Amount of thorium present mg.	Amount of thorium estimated mg.
0.240	0.252
0.320	0.320
0.400	0.388
0.480	0.464

Chemical Labs., T. K. S. MURTHY.
Andhra University, BH. S. V. RAGHAVARAO.
Waltair,
March 19, 1949.

1. Moeller, Schweitzer and Starr, *Chem. Rev.*, 1948, 42, 63. 2. Germuth and Mitchel, *Amer. Jour. Pharm.*, 1929, 101, 46.

SEPARATION OF TETRAVALENT CERIUM FROM THORIUM AND OTHER TRIVALENT RARE EARTHS—THE USE OF POTASSIUM PERIODATE

A METHOD for the separation of tetravalent cerium from thorium and other rare earths including trivalent cerium has so far not been reported, although the separation of ceric cerium as CeHIO_6 , H_2O on the addition of concentrated sodium paraperiodate has been reported by Ray Chaudary.¹ By carefully adjusting the acidity of the solution and the relative proportion of the H^+ and IO_4^- ion concentrations in solution, we

have succeeded in separating ceric cerium not only from thorium but also from other rare earths including cerous cerium.

Ceric Cerium: Ten c.c. of the ceric solution containing not more than 0.5 gm. of ceric oxide and other elements are mixed with 120 c.c. of dilute (1:5) nitric acid and 70 c.c. of the periodate reagent in the cold (the periodate reagent is prepared by saturating 1:5 dilute nitric acid with the salt). The mixture is heated for 10 to 15 mins. on a vigorously boiling water-bath and left to settle. On cooling, it is filtered through a sintered glass crucible No. 4, and partially washed with 1:10 nitric acid. The precipitate is returned to the original beaker, dissolved in the minimum of concentrated nitric acid and diluted so that the acid concentration is approximately 2N., when the cerium periodate is reprecipitated. The precipitate is filtered and washed first with about 200 c.c. of dilute nitric acid (1:10) and finally with 100 c.c. of cold water. It is then dried for three to four hours at 100 to 110°C and weighed as $\text{CeHfO}_6 \cdot \text{H}_2\text{O}$.

Thorium: The filtrate is made distinctly alkaline with ammonia when thorium and other rare earths are precipitated as periodates. The precipitate is dissolved in dilute hydrochloric acid, potassium iodide is now added in sufficient quantity to decompose the periodate and the liberated iodine is boiled off. The oxalates of the elements are now precipitated after suitably adjusting the acidity, filtered, washed, and decomposed with nitric acid. The solution is neutralised until but faintly acidic to Congo Red, and the thorium is separated by any of the known methods (preferably adopting a double precipitation) ignited, and weighed as ThO_2 .

Rare Earths: Oxalic acid is added in sufficient excess to the filtrate and the precipitated rare earths are washed, ignited, and weighed as R_2O_3 .

In the absence of thorium however, the acid and the periodate ion concentrations may vary within wider limits.

In the following table are shown some typical results in which cerium, thorium and other rare earths are separated and individually estimated.

The importance of the strength of the acid during the analysis is shown by the following experiments. When nitric acid diluted in the ratio 1:4 is employed the amount of ceric periodate precipitated is only 0.4093 and 0.4119 gm. in two determinations and with

Taken: CeO_2 0.1884 gm. + ThO_2 0.1906 gm. + other rare earths including cerous cerium R_2O_3 0.5700

Weight of $\text{CeHfO}_6 \cdot$ H_2O found	Weight of CeO_2 calcu- lated	Weight of ThO_2 found	Weight of R_2O_3 found
gm.	gm.	gm.	gm.
0.4178	0.1882	0.1902	0.5698
0.4180	0.1883	0.1904	0.5694
0.4184	0.1884	0.1903	0.5698
0.4179	0.1882	0.1902	0.5696

nitric acid diluted in the ratio 1:6 the same is 0.4240 and 0.4251 gm. in the place of the correct amount 0.4184 gm. The precipitant in both cases was a saturated solution of potassium periodate in nitric acid of corresponding dilution.

M. VENKATARAMANIAN.

BH. S. V. RAGHAVARAO.

Chemical Laboratories,
Andhra University,
Waltair,
April 30, 1949.

1. Ray Chaudary, *J. I. C. S.*, 1941, 18, 335.

TICK-BORNE RELAPSING FEVER IN KASHMIR

THE existence of Relapsing fever in Kashmir was first detected early in 1948. Previously the disease had remained unrecognised due to its mild symptoms, no fatality, and resemblance with Malaria. Two species of Ornithodoros ticks, *O. crossi* and *O. lahorensis*, were found widespread in the State, particularly infesting the animal quarters. *O. crossi* were found infected in nature and the disease conveyed to guinea pigs by their bite was similar to that produced by human-strains from local cases. It attacked man far more readily than *O. lahorensis*, also the bite marks on patients resembled those of the former. On the other hand, naturally infected specimens of *O. lahorensis* have not been found here so far, and lice could not be infected with the local strains. Therefore, it was considered that the vector of Relapsing fever in Kashmir was *O. crossi*. Detailed investigations will be published elsewhere.

K. N. A. RAO.

S. L. KALRA.

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Armed Forces Medical College,
Poona,
April 29, 1949.

A NEW METHOD FOR THE ESTIMATION OF VITAMIN-C

VITAMIN-C is the only vitamin for which reliable and simple chemical methods are found. The one generally employed is Tillman's 2:6-dichlorophenol indophenol dye titration method. But this method suffers from the disadvantage of lack of precision in the end-point with old solutions of the dye, while with fresh solutions the experimental procedure becomes tedious. Several alternative methods also are to be found, and of these excepting the method of Roe & his collaborators¹⁻³ in which the red colour produced by dehydro-ascorbic acid with 2:4-dinitro-phenylhydrazine is measured, all are based on the reducing property of vitamin-C on several reagents, e.g., methylene blue,⁴ phospho-18-tungstic acid,⁵ silicomolybdic acid⁶ arsenotungstic—and arsenotungstomolybdic acids⁷ and ferri-dipyridyl sulphate.⁸ We tried Folin's phosphomolybdic acid reagent (containing tungstic acid) for sugar and found that it gives blue colour with vitamin-C at room temperature only very slowly, taking many hours to reach the maximum. However, the colour develops rapidly at 100° C., but under these conditions fructose also produces the blue colour.

Next our choice fell on the phosphomolybdic acid reagent of Polis and Sortwell⁹. We found that this reagent gives even in the cold (30° C) an intense blue colour with such small concentrations of the vitamin as M/1000. The colour is found to be quite stable for several hours.

A number of substances (citrate, oxalate, malonate, malate, etc.) and sugars present in fruits were tested and none is found to give any colour in the cold. On heating to 100° C. few sugars gave colour, fructose yielding comparatively more colour. Cysteine and glutathione (GSH) gave no colour in the cold even with M/100 solutions. On keeping, however, a faint greenish blue colour began to develop slowly. These thiol compounds produced greenish blue colours in high concentrations, e.g. M/10, but the colours took several hours to reach the maximum intensities.

The method we have worked out, for the present for pure aqueous solutions of ascorbic acid, is as follows.

5 ml. of vit-C (M/1000 to M/100) in 10 per cent. acetic acid are treated with 0.2 ml.

of the phosphomolybdic acid reagent and shaken well. A blue colour rapidly develops and reaches its maximum intensity in about 5 mins. The colour is found to be quite stable and proportional to the concentration of vit-C. The colour can be estimated colorimetrically, preferably on a photo-electric colorimeter. A further advantage of our method lies in the fact that the blue reduction compound can be estimated by titration against M/100 potassium permanganate from a micro-burette, till the blue colour disappears and there remains only an yellow colour due to the reagent. From the titre the vit-C content can be calculated.

Further work on the application of the method for foods and biological fluids is in progress.

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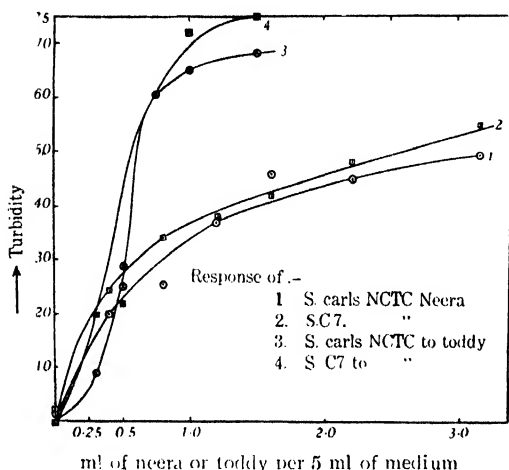
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OVERALL GROWTH-PROMOTING POTENCY OF NEERA (UNFERMENTED JUICE) AND TODDY (FERMENTED BEER) FROM *PHOENIX SYLVESTRIS*

POWERFUL growth-promoting and therapeutic properties are popularly attributed to Neera or the sweet unfermented juice of the palmyra palm, *Phoenix sylvestris*. The problem of Neera—its preservation, nutritional value and its economic disposal—has, at the moment, attained great topical significance, and as part of a comprehensive scheme of investigation, the overall growth-promoting potency of the unfermented and fermented forms of Neera

has been determined by a microbiological method described earlier.¹

Two cultures of yeasts, SC 9, NCTC 3006 and *S. carlsbergensis* NCTC 3056, whose vitamin requirements were previously determined, have been employed for all the assays and the results are graphically represented below:—



The results show that fresh and unfermented neera possesses a low overall growth-promoting potency whereas the fermented counterpart exhibits a comparatively far higher potency. As could be gathered from the curves, the potency is doubled indicating a two-fold enrichment of the growth factors during the fermentation. This is not an unexpected result in view of the well-established fact that micro-organisms synthesise and secrete vitamins during their growth. This finding would point to the perhaps provocative conclusion that if the B-complex requirements are to be met from this source, fermented toddy should be prescribed even against the policy of prohibition—a conclusion which is in conformity with the observations of Professor J. B. S. Haldane who, under the arresting caption of "Tragedy of Nauru," records that the infantile mortality among the Pacific islanders rose to 50 per cent. within six months of the enforcement of prohibition on the island. He adds "It was found that the children at the breast were dying of beri-beri, a disease due to the deficiency of thiamin. This substance is nearly absent from the rather monotonous diet of the mothers, but is present in large quantities in the yeast from which the toddy

is made. The Medical Officer of Health discovered this fact and (doubtless after an appropriate delay) toddy was allowed again. The infant mortality fell to 7 per cent.

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THE EFFECT OF COCOANUT WATER ON THE GROWTH OF IMMATURE EMBRYOS OF CORN (*MAIZE*)

TUKEY (1933 and 1934) suggested that the very young sweet cherry embryos required for their growth certain heat stable factors found in yeast and fibrin digest in addition to sugar. Van Overbeek and his associates (1941) in their work on *Datura* embryo found that embryos that did not grow in Tukey's medium containing mineral elements, did grow when to this physiologically active substances were added. Coconut water in addition, was found to help better growth in very young embryos.

In an independent experiment designed to find out the period of viability for three-week old embryos excised from corn kernels that were cold stored (Uttaman, 1949) the effect of coconut water on the growth of the embryos was noted. The embryos that were daily dissected out of a number of kernels under aseptic conditions were placed in Tukey's general purpose medium and the effect of coconut water on their germination and growth daily watched. Water from mature nuts was cold preserved at freezing point and used as and when required. They were tried in two sets. To one was added coconut water daily at the rate of 3 drops for each embryo and to the other no coconut water was added. Growth measurements were made for 4 embryos under each set, each embryo being measured for two successive days beginning from the 3rd day of placing in the medium and finally on the 5th day. The results are recorded in the table below.

It will be noted from the table that coconut water has a decisive depressing effect

Embryo	No. of days	Without cocoanut water		With cocoanut water	
		Length of shoot mm.	Length of root mm.	Length of shoot mm.	Length of root mm.
No. 1	2	30.0	30.0	25.0	4.4
	3	34.0	38.0	31.0	4.5
	6	48.0	45.0	36.0	4.5
No. 2	2	16.0	21.0	5.0	0.1
	3	30.0	36.0	10.0	2.5
	6	47.0	48.0	22.0	2.5
No. 3	2	17.0	19.0	31.0	7.0
	3	38.0	46.0	38.0	7.0
	6	69.0	56.0	43.0	7.0
No. 4	2	27.0	22.0	25.0	5.5
	3	48.0	51.0	30.0	5.5
	6	66.0	60.0	36.0	5.5

on the growth of the embryo and that the effect on the root is more pronounced than on the shoot. Van Overbeek (1941) reported that in *Datura* the roots did not develop in the presence of cocoanut water but the shoot did. This finding then is not in absolute agreement with the above results in corn.

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PRELIMINARY NOTE ON THE HETEROECISM OF *Puccinia VERSICOLOR*

Heteropogon contortus (L.) Beauv. commonly known as spear grass, is widely distributed in Mysore and forms an important grass flora of dry pasture lands. *Puccinia versicolor* Diet. & Holway, a common leaf rust of the spear grass, has been collected in abundance from several localities in Mysore. The rust is so far known to be a hemi-form with subepidermal apara-

physate uredia and telia. The urediospores are hyaline and echinulate irregularly thickened in such a manner that the cavity has radiating projections giving a stellate effect. Cultural studies of this rust undertaken to study the mode of annual recurrence, indicated that the rust is heteroecious having *Plectronia parviflora* Bedd., a member of the Rubiaceae, as alternate host. A preliminary account of the results obtained is presented here.

The uredial stage of the rust on spear grass first appears in the month of July-August, developing on yellow spots. The sori are yellowish-white in colour, erumpent and pulverulent. There is a rapid spread of the rust as a result of secondary infection incited by the urediospores.

The telia begin to develop in the month of January, first appearing as dark specks associated with yellowish-white uredia. They can be collected in abundance during the months of April and May at a time when the grass is withering due to dry conditions prevailing at the time. There are evidences to indicate that the rust does not oversummer in the uredial stage, as no viable urediospore could be collected around Bangalore in the months of April and May. The teliospores have been germinated in large numbers. The promycelium is external and four-celled bearing globular and hyaline sporidia which germinate *in situ*.

The possible occurrence of an alternate host bearing the aecial stage became evident after intensive field studies for several seasons. The uredial stage on the spear grass first appeared on clumps growing in the vicinity of *Plectronia parviflora* which is a common thorny shrub in dry waste lands. An unconnected *Aecidium* agreeing with *Aecidium Plectroniae* Cke. has been collected near Bangalore for several years. The appearance of the aecial stage on *Plectronia* in the grasslands following the rains in June, was a strong indication that it was possibly connected with some grass rust.

Inoculation experiments were carried out under laboratory conditions. Teliospores from spear grass were germinated and the sporidia were used for inoculating young unfolding leaves of *Plectronia parviflora* grown under rust-free conditions. All the inoculations were successful, the inoculated leaves developing pycnia after eight days. The development of aecia soon followed.

Several controls that were set apart, all remained healthy. The infections on *Plectronia* were produced under laboratory conditions nearly two months in advance of their natural appearance in the field.

The aëciospores produced by sporidial inoculation of *Plectronia parviflora* were used for reinoculating spear grass. Successful infections have been obtained the uredia developing twelve to eighteen days after inoculation. A detailed account is being published separately.

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June 1, 1949.

INHERITANCE OF PETAL-BASE COLOUR IN LADY'S FINGER, *HIBISCUS ESCULENTUS* LINN.

WORK on the improvement of lady's finger crop in Bihar has been carried out from 1942 and as a result of these studies, a large number of true breeding cultures for various characters have been established. The present investigations deal with the inheritance of colour at the base of the petal, studied in the following two cultures.

Culture No. 9: The petal at the base is coloured pink on both sides. The culture was isolated from the material, collected locally.

Hawaii No. 1: The petal at the base is coloured pink on the inner side, whereas on the outer side it is yellow. The culture was isolated from the material, obtained from Hawaii.

Thus the parents differed in colour on the outer side of the petal base, viz., in No. 9 it is red and in *Hawaii No. 1*, yellow. It may be added that none of the cultures under observations showed complete absence of pink colouration on both sides of the petal-base.

The cross made during 1946 succeeded only with No. 9 as female, after cross-pollinating four flowers, giving one well-developed fruit which produced fifteen seeds. The seeds germinated well and fifteen F_1 hybrids were thus raised.

All the F_1 hybrids developed pink colour on both sides of the petal-base. Thus the pink petal-base of *Culture No. 9* was dominant to the yellow petal-base of *Hawaii No. 1*, on the outer side.

Only eleven F_1 hybrids were carried forward in F_2 . Germination was rather poor, as this generation was raised during the winter months which is

not the normal season for this crop in these parts of the country. But those which germinated grew well and an F_2 population of 111 hybrids was raised, which were classified into 80 pink and 31 yellow, a close approximation to a 3:1 ratio, as shown in Table I.

TABLE I
Petal-base colour segregation in F_2 of a cross between culture No. 9 × No. 1

	No. of hybrids with pink petal-base	No. of hybrids with yellow petal-base	Total
Observed	80	31	111
Expected on 3:1 basis	83.25	27.75	111

In F_3 , progenies of twelve F_2 hybrids, three with yellow petal-base and nine with pink petal-base, were studied. The former bred true for yellow petal-base and the latter behaved, as summarised in Table II.

TABLE II
Petal-base colour segregation in F_3 of a cross between Culture No. 9 × No. 1

	No. of segregating families	No. of pure breeding families (pink petal-base)	Total	No. of plants segregating in different families		
				Pink	Yellow	Total
Observed	5	4	9	35	15	50
Expected on monogenic inheritance basis	6	3	9	37.5	12.5	50

The F_3 population studied is small, but it satisfies the expectation, based on monogenic inheritance.

Thus the F_2 and F_3 data definitely show that pink petal-base differs from yellow petal-base (outer side) by a single factor, pink-base being dominant.

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MUTATION IN *BRASSICA CAMPESTRIS* LINN. VAR. SARSON PRAIN

In one of the brown seeded varieties of *B. campestris*, an abnormal plant, having



FIG. 1

unusually curved and inflated pods (Fig. 1) appeared during the year 1945-46. An examination of the pods revealed that their inflated condition was due to the presence of one to two extra pods of smaller size which were completely telescoped into the outermost bigger pod (Fig. 2). The inner pods

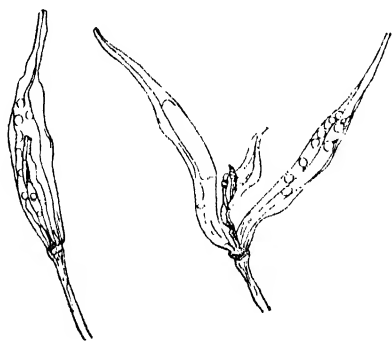


FIG. 2

looked normal and had the normal quota of ovules, though the ovules were much contorted and had smaller size than those of the outer pod. All the inner pods occurring in this plant yielded only two mature seeds, from which it appears that very few ovules in them were finally fertilized.

A cytological examination of this abnormal plant revealed the chromosome number to be

$n=10$, which is the same as that of normal *B. campestris* plants. The bulk seeds produced in the following year normal and abnormal plants in the ratio of about 3 : 1, the actual number of plants being 42 and 16. The recessive plants resembled the mutant type very closely. These facts indicate that this is a case of a natural recessive gene mutation.

Anatomical structure of the pods, morphology of the chromosomes and further breeding behaviour are being studied to reveal its true nature.

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ON THE OCCURRENCE OF *CORDYCEPS* *SPHECOCEPHALA* (KL.) SACC. NEAR CALCUTTA

THE genus *Cordyceps* includes about 200 species,⁷ and that they usually parasitise on insects, the bodies of which are transformed into sclerotia. The sclerotia usually preserve the shape of the insects and under favourable conditions give rise to stalk-like sterile stroma, with the perithecia at the distal end. The fruiting stage usually develops after the death of the host.



FIG. 1

In India only 2 species—*C. falcata* Berk. and *C. racemosa* Berk.—have so far been recorded on dead caterpillars from Khasi Hills¹, while Petch⁶ described a number of species from Ceylon. It is now proposed to add another species to the very short list of Indian *Cordyceps*, and thus bringing the total upto 3.

The *Cordyceps* specimens referred to were found in Agarpara, near Calcutta (Fig. 1).

Cordyceps sphecocephala is perhaps endemic to the West Indies on wasps. About 190 years ago Father Torrubia noted this species from Cuba. It was supposed that such species as *C. sphecocephala* was a mutation of an animal into a plant³.

Massee⁵ recorded the distribution of the species from Jamaica, Cuba, St. Vincent and Brazil. According to Llyod⁴ the species has also been recorded from Feldkirch in Austria, and that Quelet noted it from France.

Koltzsch first proposed the names of the species as above which was retained for sometime without change. But in the *Fungi of Cuba* Berkeley spelled the species as *C. sphecophila*, and under this erroneous spelling it is compiled in Saccardo³. But Massee⁵ in his revision of the genus *Cordyceps* and very recently Kobayasi² in his monograph on the genus retained the original name.

The hyphæ within the host form a sclerotic fleshy deposit, often having cottony outgrowths, usually thinwalled, $3\mu-7.5\mu$ thick, granulated inside, sometimes branching, often with swollen tips, producing oval or conical or like cells, singly or in chains, measuring $11.5\mu-22.5\mu \times 8\mu-12.5\mu$.

The stroma usually arise from the upper part of the host, very rarely from abdomen, leathery-fleshy, 2-4 cm. long, consisting of a slender, sterile stipe and a fertile head; stipe, simple, pale-yellow, fibrous, often 0.5-1 mm. thick; head elongated, usually clavate when mature, sometimes fusiform, upto 9 mm. long, 1-1.5 mm. thick.

The hyphæ composing the stipe are usually thin walled, transversely septate, $3.5\mu-7.5\mu$ thick, sometimes a few hyphæ produce somewhat swollen tips; the hyphæ between the perithecia are crossed loosely and irregularly, $2\mu-3\mu$ thick. The pseudo-parenchymatous wall is composed of usually several layers of oval rounded cells, $5.5\mu-12\mu$ across.

The perithecia are very prominent, completely and obliquely immersed, in the form of an ampule $300\mu-1000\mu$ long, $200\mu-300\mu$ broad, neck elongated ostiole not very clear. The asci upto 650μ or more long, uniformly narrow, $6-7.5\mu$ broad, spores nearly as long as the asci, breaking into narrow fusiform segments $9\mu-10\mu$ long.

Host—*Pompilus* sp.

My sincere thanks are due to Professor S. R. Bose, Calcutta, for his invaluable suggestions

and help in determining the species and making improvements in the MS., to Dr. F. J. Seaver, New York, for confirming the identification, to Dr. E. W. Mason, Kew, for sending me a transcription from Kobayasi's paper, to Mr. P. Sur and Mr. Baharuddin, Agartara, for the material through the courtesy of Mr. A. K. Ghosh, Calcutta, and Mr. P. Mitra, Calcutta, for identifying the host.

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May 2, 1949.

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STRUCTURE AND FUNCTION OF BURSA COPULATRIX AND THE ASSOCIATED ORGANS IN BRUCHIDAE (=LARIIDAE) [COLEOPTERA-PHYTOPHAGA] AND THEIR TAXONOMIC SIGNIFICANCE

In the female genitalia of Bruchidae, the bursa in *Bruchus phaseoli* Gyll. & *Bruchus analis* F., are elongated and somewhat saccular although in the latter case, it is considerably larger in size. The bursa in *Bruchus chinensis* L., *Bruchus affinis* Frol. and *Spermophagus convolvuli* Thunb., is somewhat smaller than the other two species mentioned above, the relative shape being variable among themselves. The wall of bursa in *B. phaseoli* and *B. analis* bear internally near about the middle a pair of prominent round cup-shaped structures. In the case of the latter species, however, it was found on dissection to be well developed lobular rather hollow structures attached to the wall, of the bursa and somewhat pale yellowish in colour (Fig. 3b), whereas in the case of *B. phaseoli*, they are smaller, transparent somewhat fixed organs. So far as available literatures are concerned, nothing definite is known about these peculiar structures or their

functions nor any homology is existing in other families. Although Zacher³ is of opinion that these organs function as accessory glands and secrete fluid for cementing the eggs, he concludes as follows which I quote: "Die Bideutung ist nicht klar, da mir Analogen bei anderen Familien nicht bekannt sind". In my opinion as cement secreting accessory glands for fixing the eggs are separate system of organs traceable in other insects, they cannot possibly be lodged inside the bursa which has by itself a different function altogether. Mukerji and Bhuya¹ mention that these structures function as valves occluding the proximal vaginal part from the distal portion of the bursa and thus preventing, during copulation, further penetration distad by the everted endophallic sac.* Moreover, the crenulated rim of these cup-shaped structures their hollowness (Fig. 3b) together with their natural position in the bursa do not seem to support this theory. They can, however, only be partially occlusive in function.

is comparatively smaller and the spermatheca fairly developed, these paired structures although less prominent than in the case of *B. analis*, function similarly.

It is therefore likely that each of these cup-shaped structures with opening on one side in the form of an arc, act as pouches for temporary storage of sperms ejected in the bursa just after copulation and subsequently releasing them slowly on a fold (Fig. 3 f) of the bursa to be collected slowly by the opening of the spermathecal duct (Fig. 3 Sd.).

In *B. analis* near about the level of the cup-shaped structures, there lies internally and mesially a longitudinal somewhat thickly chitinized plate which bears internally a series of curved spines. Its probable function appears to be to check the penetration of the endophallic sac or the internal sac of Sharp and Muir² beyond the cup-shaped structures. So far, this chitinized plate on the bursa has been traceable only in *B. analis* and is thus a specific character.

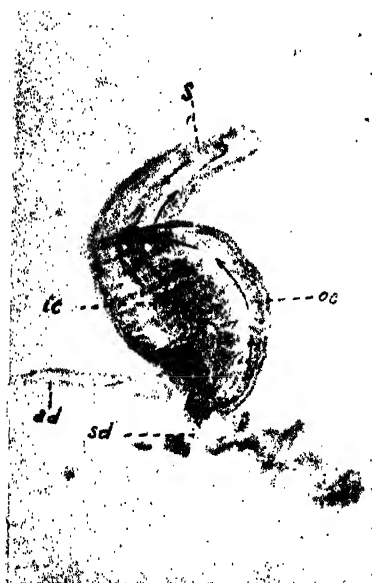


FIG. 1



FIG. 2



FIG. 3

The shape structure and position of these organs in the bursa, in the absence of any other feasible explanation, gave evidence to the fact that they probably act as primary reservoirs of sperms as in the case of *B. analis* where the bursa is comparatively larger and their spermatheca comparatively smaller in size. In the other species, e.g., *B. phaseoli* where the condition is reverse, i.e., the bursa

The spermatheca (Fig. 1) in Bruchidæ is a double chambered organ consisting of an inner chamber (i.c.) and an outer chamber (o.c.), the former being inserted into the latter. Into the inner chamber opens laterad, the duct of the accessory gland (ad) which pours its contents direct into it. The wall of the spermatheca forms the outerwall of the outer chamber while its innerwall is limited by

the wall of the inner chamber (Figs. 1 & 2, s), leaving a definite lumen between them. Distally, the inner chamber is connected with the lumen of the outer chamber by an opening (Figs. 1 & 2, o). Basally, the spermathecal duct appears to consist of a double tube one inserted into another, the inner one being connected with the inner chamber while the outer one is continuous with the wall of the spermatheca at the base forming further distad the spermathecal duct. Functionally, when the muscles of the spermatheca contract and immediately relax, a partial vacuum is created inside the spermatheca and the released sperms rush through the outer ring at the base of the spermatheca (the inner ring remaining closed) and reach the lumen of the outer chamber. From the outer chamber they reach the inner chamber through the opening at (o). These sperms thus get mixed up with the secretions of the accessory gland and undergo necessary physiological changes in the inner chamber. Subsequently, when the wall of the spermatheca again contract the basal outer ring closes on the inner ring and the mature sperms are expelled from the inner chamber through the opening of the inner tube at the base of the spermatheca into the spermathecal duct thereby reaching the vaginal portion of the bursa. Thus, the outer and inner tubes at the base of the spermatheca appear to act in the Bruchids respectively as afferent and efferent ducts for the ingress and egress of sperms.

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April 22, 1949.

*The presence of Cup-shaped structures at the distal ends of the bursa in *Bruchus minutissimus* Motsch., *B. pisorum* L., & *B. affinis* Frol., goes against such a hypothesis.

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ON SPAWNING CONDITIONS AND LARVICIDAL PROPENSITIES OF *CARASSIUS AURATUS**

In Japan gold fishes are naturally distributed even in the smallest streams and are used as food.¹ They have got themselves natura-

lised in North American waters where they are known to grow to a size of two feet^{2,3}; whereas in India they thrive only in garden pools and cisterns where they are cultured as ornamental fishes. They attain a maximum size of eight inches in length.

Although Khan⁴ has studied the spawning of this fish from the Punjab, the conditions under which it breeds have not been ascertained. An attempt was made by us to study the conditions under which the fish thrives and breeds in three different places with varying meteorological conditions in South India; and the results are briefly stated below:

Physico-chemical conditions	Madras	Mangalore	Anantharajupettah
Date	14-12-1948	27-11-1948	5-2-1949
Turbidity in cm.	>30.0	>30.0	>30.0
Temperature in °C.	24.4	29.3	27.8
pH value	7.2	7.0	8.35
Dissolved O ₂ (mg./litre)	4.6	5.2	3.5
Free CO ₂ (p.p. 100,000)	0.954	0.347	nil
Bicarbonates (p.p. 100,000)	18.610	5.185	49.833
Chlorides as chlorine (p.p. 100,000)	10.4	4.2	14.0
Silicates as SiO ₂ (p.p. 100,000)	1.4	present	2.301
Phosphates as P (p.p. 100,000)	0.004	present	0.1083
Nitrates as N (p.p. 100,000)	nil	nil	nil

The fish spawns throughout the year with maxima from May to August and from November to January. In Mangalore, South Kanara District (lat. 12° 52' N. and long. 74° 50' E.), where the climate is humid with an average rainfall of 130 inches per year and the atmospheric temperature ranges from 68 to 98°F., the fish has been observed to breed prolifically in garden ponds. It was found to spawn in cement cisterns in Anantharajupettah, Cudappah District (lat. 14° 20' N. and long. 79° 5' E.) which is one of the most arid parts of the Madras Province situated in the interior. The annual rainfall varies from 20 to 30 inches. The temperature rises to 100°F. in summer and falls to 55° F. in winter. In Madras (lat. 12° 5' N. and long. 80° 20' F.) where the mean temperature is between 75 and 88° F., the fish has been observed to breed in aquarium jars containing the City Corporation tap water. In all these places

* Published with the kind permission of the Director of Industries and Commerce, Madras.

the fish attains maturity in one year when it is about three inches in length.

The physico-chemical conditions of the above three places immediately after breeding had taken place are given below :

The embryonic and larval development were followed by us and found to agree with the observations of Khan. The larvæ were noticed to commence feeding on the fourth day on the following organisms :

Desmidiaceæ : *Closterium*, *Cosmarium* ;
Diatomaceæ : *Cocconeis*, *Cymbella*, *Gomphonema*, *Melosira*, *Navicula*, *Nitzschia*, *Synedra* ;

Algæ : *Ankistrodesmus*, *Aphanocapsa* ;

Protozoa : *Chilomonas*, *Euglena*, *Eudorina* and *Phacus*.

Adult characters were fully assumed when 25 mm. in size and one month old in all the three places. Colour varied from red, yellow, olive brown to black.

It is thus found that the gold fish could be propagated in simple garden pools and aquaria under varying meteorological conditions. This is encouraging from the point of view of the present movement to establish in popular favour for keeping and breeding fancy fishes. The gold fish is however predaceous, and has been observed to feed on young ones of *Eetroplus suratensis*, *Barbus stigma* and *B. ticto* and on its own young ones below one inch in size. Gold fish culture in ferneries and ornamental ponds is also an effective check on mosquito breeding. Atkins⁵ and Schrenkeisen⁶ have found the species to be effective larvivores. We have observed the fish to consume about 200 mosquito larvae in 24 hours. The fish can be transported over long distances without any casualty provided the water in the container is changed every six hours and the temperature is kept below 30° C.

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Kilpauk, Madras,
April 1949.

1. Otaki, K., Fujita, T., and Higurashi, T., *J. Imp. Fish. Inst. Tokyo*, 1906, **1**, 1. 2. Jordan, D. S., *Fishes*, New York, 1925. 3. Mellen, I. M., and Lanier, R. J., *1001 Questions Answered about Your Aquarium*, New York, 1935. 4. Khan, H. M., *J. Bom. Nat. Hist. Soc.*, 1929, **23**, 614. 5. Atkins, E. H., *Ibid.*, 1931, **13**, 695. 6. Schrenkeisen, R., *Fieldbook of Freshwater Fishes of North America*, New York, 1938.

ON THE OCCURRENCE OF ENTEROPNEUSTS IN SHINGLE ISLAND, GULF OF MANAAR¹

THE occurrence of Balanoglossids in Krusadai Island has already been reported.² The area where they are available in moderately large quantities has been termed as the 'Balanoglossus area'.

On the 7th, 8th and 22nd of October 1943, fifty specimens of Balanoglossids were collected from Shingle Island which lies cut away from Krusadai by a gap of over a mile and a half width. The specimens were collected from the southern shores of the Island in a small lagoon enclosed by dead coral reef. The animals were found comparatively deeper down the sand than at Krusadai.

Though systematic collections of marine animals have been made in Krusadai and nearby islands by various biologists year after year no record has so far been traced to indicate the presence of this protochordate in Shingle Island. A search for these animals in islands nearby would throw more light on the distribution and ecology of this primitive chordate.

Krusadai Island,
Gulf of Manaar,
February 1949.

G. K. KURIYAN.

1. Published with the kind permission of the Director of Industries & Commerce, Madras.
2. Narayna Rao, C. R., *Curr. Sci.*, 1934, **3**, 70.
3. Ramanujam, S. G. M., *Ibid.*, 1935-9, 427.

SEQUEL TO THE HYBRIDIZATION BETWEEN THE SUGARCANE × THE BAMBOO

PROFESSOR C. A. TAYLOR of State College of Agriculture, Brookings, South Dakota, U.S.A., considers that the systematic positions of the bamboo, sugarcane and the panicoid grasses might need revision in the light of successful hybridization between the sugarcane and the bamboo. He thinks that the floral morphology and anatomy of the genera *Arundo* and *Ochlandra* might throw some light on the problem and wishes to get into touch with researchers in India who have worked on the two genera.

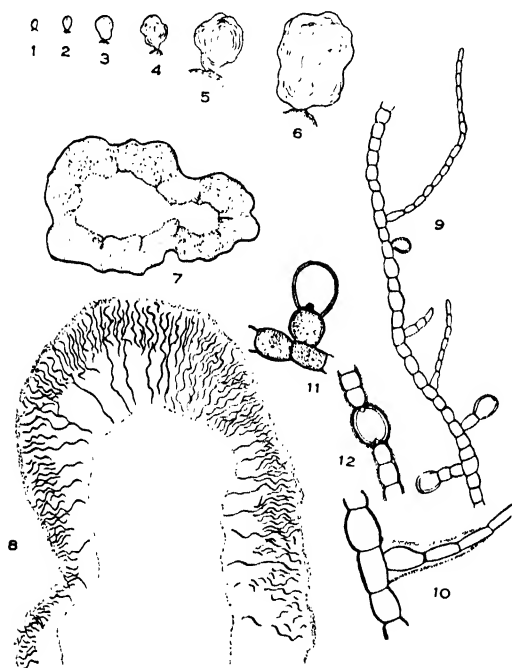
T. Nagar,
Madras,
June 19, 1949.

T. S. VENKATRAMAN.

ON A *NOSTOCHOPSIS* FROM MYSORE
LARGE collections of a species of *Nostochopsis* agreeing closely with *N. lobatus* (Wood)

Geitler were made recently in the Cauvery River which enabled a study in some detail. The alga occurs in abundance during the months from November to January, attached (Figs. 1-6) to the large boulders submerged in water and sheltered from exposure to direct currents. As the alga grows in size its attachment to the rocks becomes less firm, and finally gets detached. Consequently numerous individuals are found floating in the currents and this seems to be one of the important modes of dispersal.

The young thalli appear like small gluish-green pinheads on the submerged surfaces of the rocks. Earlier stages than these also occur on the rocks as flat slimy encrustations.



FIGS. 1-12

Figs. 1-6. Showing the development stages of the thallus. Natural size. Fig. 7. Section through young thallus to show the hollow nature $\times 2$. Fig. 8. Enlarged view of part of the same $\times 24$. Fig. 9. Portion of the trichomes at the branching zone $\times 970$. Fig. 10. Showing the development of the lateral branch $\times 970$. Fig. 11. Lateral heterocyst $\times 970$. Fig. 12. Intercalary heterocyst $\times 970$.

As development proceeds, the young balloon-shaped gelatinous thallus assumes a subspherical to globoid shape, and shows numerous convolutions. In the mature condition the thallus measures upto 20 cm. in diameter (reported to be 3.5μ by oversight by Desikachary¹), and is cinnamon-yellow

to yellowish-brown in colour. In many cases, small green islands of actively growing groups of filaments are seen on the mature thallus.

Microtome sections of the young thalli revealed that in early stages the filaments are compactly arranged without any space in the centre. However, in a relatively mature condition a large hollow space is formed in the centre (Figs. 7 & 8) as is characteristic of *Nostochopsis lobatus* described in detail by Geitler² and by Desikachary.¹ Some of the stages in the formation of the hollow space have been followed. In brief it may be stated, that the hollow space in the centre is formed as a result of moving apart, or lax arrangement of the filaments which get grouped compactly towards the periphery (Fig. 8).

Morphological study of the material collected by the writers revealed that the plant body is composed of a tangle of filaments embedded in an amorphous gelatinous matrix. A fairly large thallus is differentiated into a basal attachment region where the filaments are small contorted and without much cell contents, a middle region which is hollow or rarely traversed by groups of lax filaments, and an outermost region where the long filaments are densely grouped and have tapering ends.

Within the thallus the trichomes are radially arranged. Each trichome can be roughly differentiated into a basal region, a middle region showing branched condition and the cells manifesting beaded appearance (Figs. 9 & 10), and a projecting portion. The cells of the basal and middle regions are barrel-shaped while those of the projecting portion are cylindric to rectangular.

The heterocysts are either lateral [in which case (Figs. 9 & 11) they are either sessile or borne on one to four basal stalk cells] or intercalary (Fig. 12). The lateral heterocysts are ovate-ellipsoid to spherical, and measure $5.0-9.2 \times .5-.9 \mu$.

Grateful thanks are due to Dr. L. N. Rao, for helpful suggestions and encouragement and to Dr. M. J. Thirumalachar for help in making field observations.

H. C. GOVINDU.

Bangalore,
April 16, 1949.

B. A. RAZI.

K. M. SAFEEULLA.

1. Desikachary, T. V., *J. Indian Bot. Soc. M. O. P. Comm.* Vol. 1946, 225-38. 2. Geitler, L., "Cyanophyceae" in Pascher's *Susswasser-flora* 1925, 12, 174-76, Jena.

OCURRENCE OF HYALINE TRABÆ- CULAR CELLS IN THE MESOPHYLL OF *DERRIS BENTHAMII*

IN the course of the studies on the foliar sclereids of flowering plants the writers noticed the presence of conspicuous trabæcular cells in the leaf sections of *Derris Benthamii* Thw., which warranted a more detailed investigation. In sections of young leaves there is a single layer of palisade cells contiguous with a layer of collecting cells. Beneath this, a single layer of hyaline rounded cells forms a distinct stratum thus connecting the spongy cells below and the collecting cells at the top.

Observations indicate that as the leaves mature, the hyaline cells elongate considerably transforming themselves into long trabæcular cells (Fig. 1). These broaden out

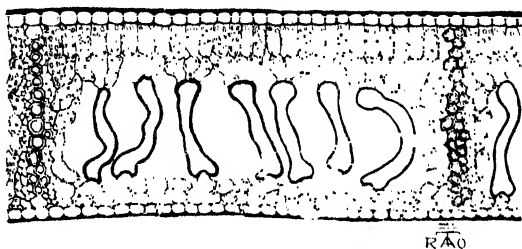


FIG. 1. Trans. section of the leaf showing the disposition of the trabæcular cells. $\times 150$.

at either ends and connect the collecting cells with spongy cells. Large air spaces are differentiated in the mesophyll as small pockets bordered and supported by the trabæcular cells. In early stages, the trabæcular cells possess dense cytoplasmic contents, and considering their articulation with the collecting cells, they appear to take part in the translocation of solutes and plastic materials within the leaf. In the mature leaves however, these cells appear vacuolate and their cell walls become conspicuously thickened with cellulose material. Many of them turn brown due to accumulation of tannin material within their lumen.

Similar, though not so conspicuous, hyaline cells usually termed as 'middle layers' have been recorded in some members of Leguminosæ including species of *Derris*, *Lonchocarpus*, *Pongamia* and others.¹ These cells are also reported to turn brown in later stages due to the accumulation of tannin material but they are never known to elongate into long trabæcular cells as seen in *Derris* species under study.

We wish to thank Dr. M. J. Thirumalachar for guidance and help.

M. R. Science Institute, T. ANANDA RAO.
Gujarat College,
Ahmedabad.

&

Agricultural College, H. C. GOVINDU.
Hebbal, Bangalore,
May 30, 1949.

1. Solereder, H., *Systematic Anatomy of the Dicotyledons*, 1, p. 258, Oxford, 1908.

SCHIZANTHUS SP. A HOST OF TOBACCO LEAF-CURL VIRUS

DURING January 1949 over 50 per cent. plants of *Schizanthus* sp. in a particular area of the Institute were found to be diseased. The infected plants were stunted and their height was below 12" whereas the normal healthy plants were over 24" in height. The leaves of affected plants were much reduced in size and bronze in colour. In general, the affected plants offered a crowded appearance. The leaves exhibited downward curling and rolling of the margins of leaflets inwards. The severely affected plants failed to produce any flowers, but the less severely affected plants bore comparatively few flowers which failed to set seed. Fig. 1 shows an infected plant of *Schizanthus*.

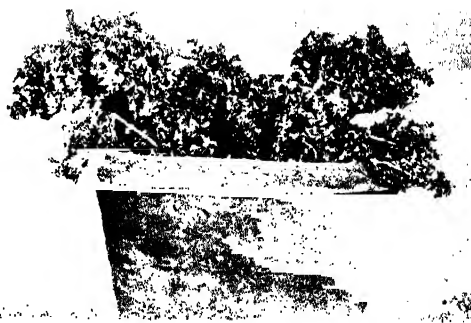


FIG. 1

All attempts to transmit the disease by inoculation with the extract of infected *Schizanthus* leaves in the presence of carborundum powder to *Nicotiana tabacum* L., varieties Harrison's Special and White Burley, *Nicotiana glutinosa* L., *Lycopersicon esculentum* Mill., variety Sutton's Early Market, *Datura stramonium* L.,

Solanum nigrum L., *Solanum nodiflorum* Jacq., and *Capsicum annuum* L., were unsuccessful.

The disease was, however, successfully transmitted by grafting to *Nicotiana tabacum* L., variety Harrison's Special, *Datura stramonium* L. and *Lycopersicum esculentum* Mill., variety Sutton's Early Market.

On *Nicotiana tabacum* var. Harrison's Special, downward curling of young leaves was observed about five weeks after grafting. This was accompanied by puckering and chlorotic areas on lower leaves. The veins on the underside of the leaves showed greening and thickening at certain places which was followed by the development of numerous small sessile, cup-shaped enations. The leaves were much reduced in size and the plant on the whole was appreciably dwarfed. Fig. 2 shows *Schizanthus* grafted to tobacco plant.



FIG. 2

Datura stramonium exhibited marked downward curling, reduction in size and mottling and wrinkling of the leaves. The symptom picture on *Lycopersicum esculentum* was almost identical with that of *Datura stramonium*.

White flies (*Bemisia tabaci* Gen.) fed in microcages on diseased *Schizanthus* plants for 24 hours when transferred to young plants of *Nicotiana tabacum*, variety Harrison's Special in the insect-proof house successfully produced typical symptoms of the leaf-curl disease.

The importance of *Schizanthus* sp. as a host of the virus lies in the fact that it may serve as a source of infection to other economic crops.

Thanks are due to Dr. R. S. Vasudeva, Head of the Division of Mycology and Plant Pathology, for his guidance.

Division of Mycology and Plant Pathology,
Indian Agri. Research Inst.,
New Delhi,
June 18, 1949.

A NEW METHOD FOR THE DIAZOTISATION OF AMINES

In connection with our work on the preparation of a few azodyestuffs from 13-amino benzanthrone, a rapid and easy method for the preparation of the diazonium salt was required. The 13-amino benzanthrone is insoluble in acids under the usual conditions and hence the diazotisation presents a special problem. A. Luttringhans and H. Neresheimer (*Ann.*, 1929, **437**, 259-89) have carried out the diazotisation of the above amine using nitrosyl sulphuric acid. The method however is not rapid and easy. We have developed a new method for diazotisation of the amine. The method can be outlined as follows:—

The amine (1 mole) is dissolved in concentrated nitric acid (3 moles). The mixture is externally cooled by ice and salt and is then treated with the calculated amount of sodium bisulphite or sodium hydrosulphite (hydros) dissolved in a small quantity of water. The temperature is not allowed to rise above 0-5°C. At higher temperatures, the reaction proceeds extremely vigorously. The reaction is complete within 3-5 minutes.

The method has been extended to other aromatic amines belonging to the benzene and naphthalene series. In all the cases studied, rapid and successful diazotisation was observed. Further work in this connection, is in progress and a detailed paper on the same, will be published shortly.

St. Xavier's College,
Bombay No. 1,
May 25, 1949.

A. DIAS.
A. N. KOTHARE.
V. V. NADKARNY.

REVIEWS

The Freezing of Super-Cooled Water. By N. Ernest Dorsey. *Transactions of the American Philosophical Society*, New Series. Vol. 38, Part 3, November 1948. Pp. 247-328. Price \$ 1.75.

In this memoir which extends well over 180 pages, Dr. Dorsey of the United States National Bureau of Standards, author of the "Properties of Water-Substance" reports the results of his investigations of the supercooling and freezing of water. These studies though carried out intermittently, extended over a period of twelve years. The report does not contain any startling results; but it is a record of the basic facts concerning the subject.

The primary purpose of the investigations according to the author was to determine how variable might be the temperature to which a given specimen hermetically sealed in a glass bulb can be supercooled, and whether and to what extents the supercooling is affected by (1) agitation, (2) thermal shock and (3) length of time that the specimen had been supercooled. The results obtained have been compared with those which have been widely believed to be demanded by the kinetic theory of freezing called the "homogeneous theory" and the author has come to the conclusion that the above theory is entirely inapplicable within the range of supercooling covered by this work. A new and explicit heterogeneous theory of freezing, which accounts qualitatively for the observed phenomena has been outlined and discussed. A bibliography containing 166 references to original papers has been included.

R. S. K.

Svalöf (1886-1946). History and Present Problems. Edited A. Akerman, Ph.D., et al. Lund, 1948. Pp. 389. Price £ 1-10-0 or 20 Swedish Kronen.

The Swedish Seed Association celebrated its sixtieth anniversary in 1946. In connection with this anniversary it has produced this volume bearing the name of the Swedish village Svalöf, which is now known to all the plant breeders, owing the plant breeding station located there and administered by the above association.

This volume is symposium by the different specialists concerned with agricultural improvement in Sweden and directly connected with Svalöf station. The different papers deal with

the organisation and history of the station, as well as the practical and theoretical aspects of plant improvement for Swedish agriculture. The editors are Doctors A. Akerman, O. Tedin and K. Fröier and the English technical editor is Dr. R. O. Whyte of Aberystwyth. In the twenty-two papers, a clear picture of the activities of the research station is presented, and owing to the high quality of the work, is a welcome contribution to knowledge of plant breeding.

The name Svalöf is to many, connected with a method of selecting from hybrid progenies. As can be expected from the record of the station the chapters dealing with hybridisation and selection, generally, or in specific crops, is critical and informative, and is likely to be of use to plant breeders in India. In use of X-ray in induction of useful mutations, the Svalöf station has made considerable effort and the relevant chapter is of interest. Dr. Levan deals with the cytogenetic aspect of breeding, and discusses the production and utilisation of polyploid crop plants. In this new branch, very few successes can yet be recorded, but Svalöf is testing and developing a promising line of work, the amphidiploid wheat-rye hybrid and this is discussed by Dr. Arne Muntzing.

The avowed function of the book, 'to indicate the willingness of Swedish Plant Breeding to take part again in the international collaboration of scientific plant breeders' is well fulfilled. The typography and illustrations is of the high standard familiar to readers of '*Hereditas*'. The occasional awkwardness in English idiom and usage is scarcely noticeable by the reader interested in its technical content.

C. G.

Growth Substances and Their Practical Importance in Horticulture. By H. L. Pearse. (Aberystwyth): Commonwealth Bureau of Horticulture and Plantation Crops. *Tech. Com.*, No. 20), 1948. Pp. 233. Price 12 sh. 6 d.

The Commonwealth Bureau of Horticulture and Plantation Crops has brought out previously two communications on plant hormones with regard to their practical importance in horticulture. These communications are (1) *Plant Hormones and Their Practical Importance in Horticulture* (*Tech. Com.* No. 12) by H. L. Pearse, who is also the author of the communi-

cation under review and (2) Fruit Fall and Its Control by Synthetic Growth Substances (*Technical Com.* No. 18) by M. C. Vyvyan. In *Technical Communication* No. 20 Pearse has not only incorporated the information included in *Technical Com.* No. 12 and 18 but has also added considerably by referring to more recent information available on the subjects.

The summarising of the vast literature available on growth substances has been done under different headings in respect of their uses. The first section deals with use of growth substances in vegetative propagation followed by others on treatment of seeds and seedlings, treatment of growing plants and induction of parthenocarpic development of fruit. The last but one section which deals with selective hormonal weedicides is although of practical importance in horticulture has a far wider application in general agronomic practices since control of weeds in crops is of greater importance. The last two sections deal with the inhibition of bud development and other practical uses of growth substances respectively.

Since hormones are responsible not only in promoting growth but also in its inhibition it is not surprising to find the number of different horticultural practices to which growth substances can be put to use. The varied uses of growth substances are very clearly summarised and horticulturists will find the information given of considerable help.

Practical hints of importance given are those relating to the substances to be used for the different purposes, their dose, duration of treatment and method of application. The effect of growth substances on histological development and the physiology of treated plants are also dealt with.

185 pages or nearly three-fourths of the communication is devoted to an index of typical results obtained by the use of growth substances on cuttings of over 880 plant species including varieties and hybrids. This information would be of considerable importance to workers who desire to investigate further the effect of growth substances on other untried species.

The exhaustive work done by Pearse can easily be gauged by the extended bibliography furnished at the end which includes over 1465 references. Even at that the author modestly states that reference has been made to as many works as possible and that possibly there may be some omissions. Of the references furnished it is observed that more than 1275 fall within the period of 1927 to 1948 which indicates that a greater amount of work on growth sub-

stances has been carried out during the past two decades.

Horticultural workers the world over should be indebted to Pearse for summarising the extensive literature on growth substances in a manner that would be useful to laymen as well as advanced workers in the field and they should also be thankful to the Commonwealth Bureau of Horticulture and Plantation Crops for bringing out the communication which will be of inestimable value to further work.

L. S. S. KUMAR.

Five Figure Tables of Mathematical Functions. By J. B. Dale. (Edward Arnold & Co., London), Second Edition, 1949. Price 6 sh. net.

This book of tables whose first edition appeared in 1903, and which was reprinted several times now appears with some slight changes. The book is intended for advanced workers in Applied Mathematics and Statistics. It contains, besides the usual logarithmic and trigonometric tables, tables of the Bessel Functions $J_0(x)$, $J_1(x)$, $J_n(x)$, $I_n(x)$, Tables of the Probability Integral $\text{Erf}(x)$, Tables of the Elliptic functions

$$E(K, \phi) = \int_0^\phi (1 - k^2 \sin^2 x)^{\frac{1}{2}} dx$$

$$F(K, \phi) = \int_0^\phi (1 - k^2 \sin^2 x)^{-\frac{1}{2}} dx,$$

where $\sin \theta = K$, and some other tables.

The book is not a compendious treatise like the famous Jahnke-Emde tables, but is a handy book of 121 pages, and should on that account prove popular for the type of students for whom it is intended.

C.N.S.

Anatomy of *Semnopithecus entellus*. By A. Ananthanarayana Iyer (Indian Publishing House), 1948. Pp. 182.

This book is the outcome, according to the author, of the numerous requests of the fellow-workers to have in print an anatomical account of *Semnopithecus* which was submitted by the author as a thesis for the M.Sc. degree of Madras University in 1942.

While fragmentary anatomical accounts of the sacred Indian Langur were available, no connected account of all the systems could be had and the book before us, aims at giving an account of all the systems of the Old World monkey and also examines the interrelationships of the Primates.

After discussing the systematics of the group (Chapter II), externals are described in

Chapter III, flexor lines and papillary ridges (dermatoglyphics) in Chapter IV and the skeleton in Chapter V. *Semnopithecus* shows the lacrimo-ethmoidal apposition and it would have been very useful if the causes and modifications responsible for the erect-sitting of the Langur were narrated. We are not impressed with the figures 2, 3, 13 and 14; better photographs could have been reproduced.

The Langur lacks an inguinal ligament (Chapter VII) and the system is described in great detail (Chapter VIII). With regard to the facial musculature, the author argues that the musculature is generalised and the buccal herniae have in no way altered it.

The author has definitely been able to to confirm that the stomach is not of the ruminant type though spuriously resembling it. Barring *Lemuroidea*, the *entellus* stomach is tripartite like that of the Primates and each part is subservient to its mode of diet.

While describing the ductless glands, independent ones (Chapter XVI) which function as endocrine glands are described omitting discreetly the pancreas. The heart and the principal vessels are dealt with in Chapter XVII. For a student of human anatomy, the blood vascular system of *Semnopithecus* is not very different except for the too frequent variations met with in the venous system. In the chapters of the nervous system the labellings of the fissures, etc., is impossible to read. *Semnopithecus* brain occupies a very high position among that of the *Cercopithecoid* series and it is hoped that the author will be able to give an account of its minute structure.

Chapter XXI is devoted to recounting a set of twenty significant features of *Semnopithecus*. An exhaustive bibliography and index follow.

A number of minor errors have crept in; *Semnopithecus* (pp. 129, 106) and *Macacus* (p. 108) commence with a small letter; cutaneous is wrongly syllabified (p. 45, fig. 27); xithoid for xiphoid (p. 83, fig. 61); Palæontology for Palaeontology (p. 174); photo 76 does not show what it is intended to. No uniformity is observed in citing years of references (pp. 47 and 48); the use of definite article before generic names (pp. 104, 110, 112) and structures named after discoverers [Spigelian lobe (p. 104), Sylvian fissure (p. 140)] is undesirable. The term 'Entellus' (pp. 140, 145) should have been in italics. Finally reference to Sutton is not given in the bibliography.

The book is a valuable addition to our know-

ledge of the Old World monkey serving as a companion volume to "The Anatomy of the Rhesus Monkey". A study like this will not only enable us to gain a better comparative account and knowledge of the higher Primates but also help us to place systematically the group on a firmer basis.

L. S. R.

Report of Proceedings of the Specialist Conference on Geology and Mineral Resources, London, September 1948 (His Majesty's Stationery Office), 1949. Pp. 1-18; Price 6d. net.

The British Commonwealth Scientific Official Conference held in 1946, had suggested that certain of the subjects may be discussed in Specialist Conferences called at suitable intervals availing of the opportunities provided by the presence of delegates from the Commonwealth Countries at International Congresses or Meetings. Accordingly, just after the close of the International Geological Congress which was held in London from August 5th to September 18th, 1948, a meeting of the geologists representing United Kingdom, South Africa, Southern Rhodesia, Canada, India, Australia, New Zealand, and the Colonies, was convened. It was not a gathering for discussion of Scientific Papers on Geology and Mineral Resources, but was expressly invited for drawing up concrete proposals for Commonwealth collaboration. In drawing up the proposals, the members were not bound by any of the suggestions or directives made by the 1946 official Conference, and Sir Edward Appleton in his opening remarks to this Conference advised the members themselves to decide first what the objectives were and then to formulate the kind of machinery required to attain them.

The Conference met for 3 days and discussed many questions—such as the facilities existing and required for a proper survey of the mineral resources and reserves of the Commonwealth, presentation of Mineral Statistics, training of geologists, geophysical prospecting, photo-geology, palaeobotany, clay minerals, coal research, and publications. A number of recommendations have been made. The constitution of a permanent committee to be known as the Committee on Mineral Sources and Geology with members from each of the participating Commonwealth Countries,—together with some details regarding the executive and secretarial work of this Committee—have been recommended. As regards presentation of Mineral

Statistics, it was decided that the question of formulating the degree of standardisation should be discussed at the Commonwealth Statisticians Conference scheduled to meet in Australia.

The Conference while noting with satisfaction the increased facilities being provided for the assessment of mineral resources by the respective governments, has recommended that salary scales and career opportunities for Geologists throughout the Commonwealth should be comparable, and also that the requisite standard for entrance into the official geological surveys be maintained by prescribing a good honours degree or its equivalent in geology, preferably supplemented by post-graduate research work. Another resolution is to the effect that Governments should further the study of specialised problems in geology, geophysics and mineral investigations by facilitating either exchange of specialist workers or visits of specialists from one country to another. Such personal contacts would be a more effective way of securing mutual co-operation and understanding between the workers in different countries.

Amongst the resolutions relating to publication, two are very important: (i) that a central organisation like the Geophysics Department of the Imperial College of Science in London, might be invited to act as a centre for co-ordinating and disseminating the information contained in reports of geophysical investigations, and (ii) that the Geological Surveys throughout the Commonwealth should take steps to publish an annual volume of abstracts of all geological papers published relating to the territories for which they are responsible.

All the various recommendations of the Conference appear practicable and there is no doubt that the Commonwealth Countries, individually and as a whole, will stand to benefit if early steps are taken to implement the substance of these resolutions.

M. B. R. RAO.

A Prospector's Handbook to Radioactive Mineral Deposits. *Department of Scientific & Industrial Research, Geological Survey and Museum.* (London: H. M. Stationery Office), 1949. Pp. 1-28. Price 6d. net.

Ever since the possibility of utilizing Atomic energy was established, the search for ores containing uranium and thorium has received great impetus. Naturally, there is much eagerness on the part of Geologists, Pros-

pectors, and persons connected with the promotion of mineral industries, for procuring useful practical information on the mode of occurrence, methods of identification, processes of concentration, and commercial intelligence concerning the radioactive ores. This Handbook supplies such information, and is a welcome addition to the growing literature on the subject.

After furnishing a description of the economically important minerals which number about a dozen, a concise but quite comprehensive account is given of the geological conditions in which the radioactive mineral deposits have been found in different parts of the world. On the basis of the knowledge and experience gained, valuable hints are given for exploration in virgin territory as to the nature of the rock-formations and geological associations which are likely to be favourable for the location of radioactive minerals.

Supergene deposits, polymetallic deposits, pegmatites, carnotite deposits in sedimentary rocks, placer deposits, and other notable occurrences which are important sources for these ores, have been described.

The possibility of obtaining radioactive ores as by-products from certain of the existing mines in the tailings and other discarded products from the quarry dumps, has been pointed out. Instruments and methods of detecting the presence of radioactive minerals have been explained. The use of portable Geiger Muller counters, fluorescence lamps, photographic techniques and some special chemical tests have been described with up-to-date information, in sufficient details to serve the practical needs of the geologist and the prospector. It would have been better if a list of the instruments which have now come into the market under various trade names such as "Radioactivity Detector," "Mineralight," etc., also had been furnished in an appendix stating the addresses of the manufacturers and suppliers. However, those specially interested in purchasing the instruments and intending to do active exploration, would do well to consult any of the official Geological Surveys engaged in work on radioactive minerals.

The market for radioactive minerals usable for nuclear fission may be said to be almost unlimited. No other ores or mineral products command at the present time such an enviable position in the commercial world. To promote exploration for such minerals throughout its colonial territories, the British Ministry of

Supply have announced the minimum guaranteed prices for uranium ores of stipulated grade—an offer to hold good for the next ten years. The terms and conditions of purchase are set forth in the last chapter.

Dr. C. F. Davidson, Chief Geologist, Geological Survey of Great Britain, who has so ably written this Hand Book, has brought together in a very short volume much useful and up-to-date information on the subject.

M. B. R. RAO.

"A Dictionary of Metallography". By R. T. Rolfe. (M/s. Chapman & Hall Ltd., London). 1949. Pp. xii+287. Price 18 sh. net.

This book is the first of its kind to offer the

reader such comprehensive data on metallurgical subjects for which normally one has to look up an unlimited number of books and journals—a very tedious task indeed. By presenting the entire data in an admirably concise and scientific manner, the author has filled a sorely felt gap in the library of metallurgical texts.

The book will undoubtedly capture the interests of the students, research workers and of professional metallurgists and engineers the world over.

The author deserves warm congratulations for his service to the community of Metallurgists.

B. R. NIJHAWAN.

SCIENCE NOTES AND NEWS

High Altitude Research Station

On the recommendation of the Council, a party of three scientists visited Sikkim and Jumontri on the Himalayas for selection of a suitable site for the establishment of a High Altitude Research Station. The Committee will soon visit the Baralacha area, after which final selection of the site will be made.

An expert Sub-Committee, consisting of eminent scientists, is drawing up a detailed plan for the Research Station, which will be fully equipped to handle snow survey and glaciology, meteorology, astronomy and cosmic ray research and investigations on mineral resources and the flora and fauna of the Himalayan regions. The Research Station will function under the joint auspices of the Council, the Central Waterpower, Irrigation and Navigation Commission and the Indian Meteorological Department.

Council of Scientific and Industrial Research

New Schemes of Research

On the recommendations of the Board of Scientific and Industrial Research, the Governing Body of the Council has sanctioned the following new schemes of research at a cost of Rs. 1,50,000.

1. Synthesis of Citrinin and preparation of derivatives of Citrinin—Dr. K. Venkataraman, Bombay.
2. Elucidation of the constitution of essential oils and their synthesis—Dr. P. C. Guha, Bangalore.

3. Physico-chemical properties of hides, tanned and untanned—Dr. B. N. Ghosh, Calcutta.
4. Scheme of research on leather—Mr. B. M. Das, Calcutta.
5. Studies on colloidal instability of cloud particles above and below the freezing temperature—Dr. S. K. Banerjee & Dr. L. S. Mathur, New Delhi.
6. Polarisation of downcoming radio waves—Dr. S. R. Khastgir, Benares.
7. Cellulose decomposition by soil fungi with special reference to its application in fermentation technology—Dr. T. S. Sadasivan, Madras.
8. Enzyme bates—Mr. S. N. Sen, Calcutta.
9. Research on soft X-rays—Prof. S. N. Bose, Calcutta.
10. Development of magnetic dust cores—Mr. B. D. Toshnilal, Bombay.
11. Development of an electronic type of frequency analyser—Dr. N. B. Bhatt, Bangalore.
12. Study of intensity variation of shortwave radio signals and their bearing on the Ionosphere—Dr. S. S. Banerjee, Benares.
13. Studies of correlation between abnormal variation of region F ionisation of the ionosphere and similar variation of the Night Sky Emission—Dr. S. N. Ghosh, Calcutta.

Housing of the Scientific and Technical Societies in Calcutta

A proposal has been sponsored for the housing of the offices of the scientific and technical societies in a central locality in

Calcutta. The proposal envisages the provision of an attached well-equipped scientific and technical library, a science museum, an appropriate number of lecture and meeting rooms and also temporary residential accommodation to visiting members and other eminent scientists and specialists from different parts of India and overseas. Under such a scheme, the disabilities which many of the institutions now suffer from would be largely removed, and better scope would be available for the informal discussion and solution of many problems which have arisen and will arise in the scientific and technical fields. It will also be possible to bring about frequent joint discussions of specialists representing the different sciences to effect a better appreciation of each others' views and scope of work, and the widening of the horizon of scientific knowledge, by removing the barriers which tend to confine the specialists to working in water-tight compartments.

The representatives of the scientific societies and learned bodies who met to consider the proposal have been unanimous in their support and a committee has been formed to suggest ways and means of implementing the proposal.

Among the institutions whose support has already been obtained are—

Indian Science Congress Association; Indian Institute of Chemical Engineers; Indian Institute of Metals; Zoological Society of Bengal; Geological, Mining and Metallurgical Society of India; Botanical Society of Bengal; The Mining, Geological and Metallurgical Institute of India; Bangya Vignyan Parisad; Science Club; and Physiological Society of India.

In addition the following societies are also giving consideration to the matter—

Royal Asiatic Society of Bengal; Indian Chemical Society.

The National Institute of Sciences of India has nominated a representative to take part in the joint deliberations of the societies.

Research-Club

Addressing the members of the Research-Club, H.B.T.I., Kanpur, Mr. M. G. Gupta traced the history and theory of anodisation and colouring of aluminium and said that the problem of protection of aluminium and its light alloys from atmospheric and chemical corrosion is of great commercial importance specially in Naval and aircraft industries. Anodisation has not only fulfilled the commercial

demand but also developed an æsthetic aspect of the use of metal. It has now revolutionised the metallurgical conception of the modern age.

Continuing Mr. Gupta said that the anodisation was an electrolytic process similar to the electroplating and by electrolysis of acidulated water develops on the metal a thin film of Al_2O_3 , which besides being an auto-corrosive acts as a mordant for acid organic dyes, paints, varnishes, etc. Discovery and commercial exploitation of this process has opened a new chapter in the fabrication of the metal. To-day aluminium articles can be made in every shape, shade and colour.

Mr. Gupta opined that the industry was a very paying one and with a capital investment of about Rs. 75,000 a net profit of about 35% can be expected. At present there is only one factory in U.P. and about half a dozen factories in the rest of India working out this process. To-day India needed many more such factories.

Concluding the speaker said that only recently anodised aluminium sheets have been used for making photo-prints and for producing beautiful multi-coloured articles and name-plates.

Coconut Research Scheme, Ceylon

Dr. Reginald Child has relinquished the post of Director of the Coconut Research Scheme, Ceylon, which he has held since 1932. He will be succeeded by Mr. F. C. Cooke, B.Sc., A.M.I. Chem.E., who was Chemist (Coconut Products) with the Department of Agriculture, Malaya, from 1929-1938, and Canning Officer of the same Department from 1946 to 1949.

Central Committee on Soil Science

The Government of India have decided to appoint a Central Committee on Soil Science with a view to guide and co-ordinate the scientific study of soil in the country which is essential to put agricultural production on a planned basis. Composition of soil, its depth, its nutritional properties, mineral and moisture contents, etc., play a large part in intensive cultivation schemes which aim at producing the maximum out of the soil without impairing its fertility in any way.

The functions of the Committee will be:

to advise the Government of India on matters of soil research and soil surveys;

to guide and co-ordinate the scientific study of soil so as to ensure that soil survey proceed on right lines;

to lay down the lines of soil survey to be followed for purely scientific and specific utilitarian purposes, and soil survey training;

to preserve in a central place the soil profiles representative of various types of soil;

to provide for the interchange of information and samples regarding soil types amongst the workers within the country as well as in foreign countries.

The Committee will be composed of:

1. Dr. J. N. Mukherjee, Director, Indian Agricultural Research Institute (*Chairman*).
2. Dr. Dalip Singh, Principal, Government Agricultural College, Amritsar.
3. Dr. J. K. Basu, Soil Physicist, Government of Bombay.
4. Mr. P. D. Karunakar, Agricultural Chemist, Government of Madras.
5. Dr. R. C. Hoon, Officer on Special Duty, Central Waterpower, Irrigation & Navigation Commission.
6. Dr. B. K. Mukherjee, Director, Sugarcane Research Station, Shahjehanpur, U. P.
7. Dr. A. T. Sen, Soil Conservation Officer, Ministry of Agriculture, and
8. Soil Survey Officer of the Indian Agricultural Research Institute (*Technical Secretary*).

The Committee will function under the Central Ministry of Agriculture. Soil profiles from various Provinces and States will be preserved at the Indian Agricultural Research Institute, New Pusa, and the work on the preparation of soil maps of India, according to the lines laid down by the Committee, will be entrusted to the Institute.

British Association for the Advancement of Science

The next annual meeting of the British Association is expected to be held in New Castle-upon-Tyne from August 31st to September 7th 1949. Sir John Russell, F.R.S., the President of the Session, will deliver the Presidential Address on "World Food and World Population". Among the evening discourses scheduled to be delivered during the session is the one to be given by Dr. Hans Pettersson, Leader of the Swedish Deep-Sea Expedition, on Exploration of the Ocean Floor.

A full programme giving detailed arrangements will be published about August 10 and will be sent to all who intimate their intention to attend the meeting.

Institute of Jute Technology

An Institute of Jute Technology is in the process of being jointly sponsored by the University of Calcutta and the Indian Jute Mills Association. The Institute, which is estimated to cost Rs. 20 lakhs on capital expenditure and Rs. 2 lakhs recurring annually, will conduct research and train personnel for the industry.

Research in Yoga

The Government of India have sanctioned a grant of Rs. 20,000 to Kaivalya Dhama, an Institute for training in Yoga, to conduct research on the scientific aspects of Yoga. The Institute has been functioning at Lonavla, near Bombay, for the last 24 years. According to Swami Kuvalayananda, Founder Director of the Institute, the aim is to "develop a philosophy and a culture through the co-ordination of yogic experiences and modern sciences that would lead to a proper understanding of man as a whole and thus avoid any future conflicts between man and man".

World Forestry Conference

President C. R. Ranganathan of the Forest Research Institute, Dehra Dun, will represent India at the World Forestry Conference which is scheduled to meet at Helsinki during the middle of July (10th to 20th July). The conclusions reached at the Regional Conference held recently at Mysore will come up for discussion. The agenda for the plenary session includes discussion on forest resources and requirements, repurcussion of industrial and chemical development on silviculture and forest management.

Big Engineering Exhibition in Glasgow

Scotland will play an important part in the Festival of Britain to be held in 1951. One of the main displays connected with the Festival will be staged in Glasgow and will be one of the four major exhibitions to be held outside London.

It will be planned to illustrate the theme of Britain's contributions—past, present and future—to heavy engineering and shipbuilding. It will last about 14 weeks and is expected to attract at least 1,000,000 visitors. No similar exhibition has ever been organised on so large a scale before. It will vividly present the story of a century's progress in all forms of heavy engineering.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Applications are invited from subjects of Indian domicile or descent and others for the post of Director, Central Drug Research Institute, Lucknow (India).

Pay: Rs. 2000-100-2500.

A higher initial salary in the above scale can be offered to a candidate of outstanding merits.

(ii) **Age:** 40 to 50, relaxable only for Government servants and persons of outstanding ability and merit.

(iii) **Qualifications :**

- (a) Doctorate Degree in Science or Medicine of an Indian or Foreign University and in active participation of research in any field pertaining to drugs and pharmaceuticals, including Indian indigenous drugs.
- (b) 10 years training in methods of drug synthesis, drug testing, standardisation, chemotherapeutic and micro-biological research procedures as employed to drugs.
- (c) Wide experience in organisation and administration.
- (a) Capacity to initiate, conduct and direct research on drugs, and ability to integrate the research work of different groups of scientists engaged on various aspects of drug research, and assume leadership in the field of drug research.

A post-graduate Degree in Medicine, equivalent to a D.Sc. or Ph.D. with additional training in pharmaceutical science or pharmacology and Chemotherapeutic work will be accepted as equivalent qualification. None need apply who has not got mature experience in the field of Drug Research with high academic qualifications and previous teaching and Research experience in a University or Research Institute of University calibre.

Applications with copies of testimonials and published papers should reach the undersigned by 31st August 1949.

SECRETARY

**Council of Scientific and
Industrial Research
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THE AHMEDABAD EDUCATION SOCIETY

Applications are invited for the post of Professor of Theoretical Physics in the Physical Research Laboratory, Ahmedabad, on a salary scale of Rs. 800-40-1000-50-1200. The Professor will be required to undertake research and train research students in Modern Theoretical Physics.

Applications giving age, qualifications, copies of published papers and testimonials should reach the Director, Physical Research Laboratory, Navrangpura, Ahmedabad 9, before 1st September 1949.

Candidates applying from overseas may send brief advance applications by air mail giving all essential information.

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COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Applications are invited for the undermentioned posts in the National Chemical Laboratory, Poona :—

**Junior Scientific Officers (16) Scale Rs. 275-25-500-
EB-30-590.**

Senior Scientific Assistants (20) Scale Rs. 250-25-500.

Junior Scientific Assistants (25) Scale Rs. 160-10-330.

Candidates for these posts should at least possess an M.Sc. (1st Class) or equivalent degree of any recognised University or Institution. Research work carried out and published papers, if any, by the candidates will be considered as additional qualifications.

Full particulars and forms of application can be obtained from the Secretary, Council of Scientific and Industrial Research, New Delhi. Last date for submission of applications is 15th September 1949.

Candidates who had applied previously need not submit their applications again. They should, however, intimate additional qualifications, experience, etc., if any, gained, subsequent to the date of their previous applications.

SECRETARY

Council of Scientific & Industrial Research

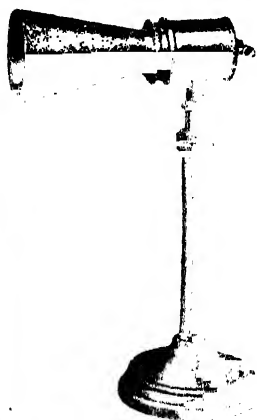
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30, MOUNT ROAD, MADRAS 2

29, REGAL BUILDINGS, NEW DELHI 1

Current Science

Vol. XVIII]

AUGUST 1949

[No. 8

	PAGE		PAGE
<i>Role of Science in National Reconstruction</i>	269	<i>The Indian Chemical Society</i> ..	282
<i>A Study of the Microtonal Variations in Frequencies in Karnatic Music—C. S. AYYAR</i> ..	272	<i>Letters to the Editor</i> ..	284
<i>Indian Dairy Research Institute</i> ..	274	DR. J. N. MUKHERJEE ..	307
<i>Caustic Embrittlement of Boiler Plate and Rivet Steel—B. R. NIJHAWAN</i> ..	275	<i>Reviews</i> ..	308
<i>Nature Conservation and National Parks</i> ..	279	<i>Some Methods of Purification and Industrially Important Reactions of p-Cymene—JAMES VERGHESE</i> ..	315
		<i>Science Notes and News</i> ..	317

ROLE OF SCIENCE IN NATIONAL RECONSTRUCTION

THE Government of India has on the occasion of the second anniversary of the Independence Day, reviewed the position with respect to the establishment of 11 National Laboratories which are expected to play a vital role in the context of National reconstruction. The amount to be spent on construction and equipment of institutions intended to serve the needs of such a vast country as India—the total cost will be Rs. 3,80,50,000—is small compared with the large sums spent on research in countries like the U.S.A. and the United Kingdom.

These National Laboratories are being organised under the auspices of the Council of Scientific and Industrial Research. Each laboratory will cover all aspects of research in its respective field and will be equipped

with semi-process or pilot-plant facilities for translating laboratory investigation into industrial practice.

The roles played by both fundamental and applied aspects of research have been fully recognised, and the laboratories are intended not merely to aid a particular industry with knowledge that is already available but also in the furtherance of such knowledge. Problems bearing on wider social aspects affecting the welfare of the community will also come within their purview, and they should be in a position to try alternative approaches to a problem simultaneously. It is not intended however that work of a kind ordinarily within the scope of research laboratories of industries or of Universities shall be undertaken.

NATIONAL PHYSICAL LABORATORY

Largest of the laboratories, the National Physical Laboratory is being located in Delhi. Its functions will be similar to those of the National Physical Laboratory in the U.K. and the Bureau of Standards, U.S.A. It will have eight divisions, dealing with weights and measures, applied mechanics and materials, heat and power, optics, electricity, electronics and sound, hydraulics, and analytical chemistry. It is also proposed to attach a division of industrial physics, so that discoveries made at the laboratory may be worked out on a semi-commercial scale.

The Laboratory, the main wing of which is expected to be ready by the end of this month, is being built on a site of nearly 60 acres and is estimated to cover a total floor area of 220,000 sq. ft. Fully air-conditioned, it will be manned by more than 250 scientists and technicians.

NATIONAL CHEMICAL LABORATORY

A special feature of the National Chemical Laboratory—under construction at Poona—will be the development of new processes up to the pilot-plant stage so that industry may be induced by the practical results obtained to adopt the processes developed for large-scale production. A pilot-plant for the manufacture of chemical cotton is at present being established.

This Laboratory will have seven main divisions, devoted to inorganic chemistry, physical chemistry, chemistry of high polymers, organic chemistry, bio-chemistry, chemical engineering, and survey and intelligence. The staff will consist of about 150 scientists.

NATIONAL METALLURGICAL LABORATORY

To be established at Jamshedpur, the Metallurgical Laboratory will cover a total working area of 63,000 sq. ft. and its staff will include more than 100 scientists. Besides metallurgical research, it will undertake research on ores, minerals and refractories as applied to metallurgy. A noteworthy feature will be the Laboratory's collaboration with Tata's, and already one result of this collaboration is a scheme for the

substitution of manganese for nickel in austenitic steels. Specialists from the Laboratory will also be sent out to render technical advice to industrial firms in respect of other metallurgical operations.

FUEL RESEARCH INSTITUTE

Research already under way at the Fuel Research Institute, being built at Digwadih, in the Jharia coalfields, is of considerable importance to India's industrial development, and the results obtained so far on blending of coal for coking, and washing of coal have evoked wide interest. The Government of India recently appointed a committee, under the chairmanship of Dr. M. S. Krishnan, to advise on the adoption of these results on a large scale.

The Fuel Research Institute, which will undertake work in connection with Government's plans for production of synthetic liquid fuel, low temperature carbonisation, utilisation of coal-tar products and introduction of pulverised coal in boilers (locomotive as well as stationary) will be manned by a scientific and technical staff of more than 150.

**CENTRAL GLASS AND CERAMIC
RESEARCH INSTITUTE**

The Central Glass and Ceramic Research Institute's building is nearing completion in Calcutta.

It is proposed to set up a pilot-plant for optical glass manufacture. A sand-washing plant has already been installed, and following a survey of glass sands in the United Provinces, Central Provinces, Bihar, Punjab, Bombay, Madras and Travancore, more than 120 samples have been analysed and graded. Research work on multi-cellular glass and coloured glass is under way.

CENTRAL LEATHER RESEARCH INSTITUTE

Plans have now been drawn up for a full-fledged Central Leather Research Institute in Madras.

Sections will be devoted to leather testing, chemistry, bacteriology, microscopy and physics. There will also be a model research

tannery, a pilot-plant for tannin extraction and glue manufacture, and a workshop.

CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE

Set up under the auspices of the C.S.I.R., the Central Food Technological Research Institute is housed in the Cheluvamba Mansion in Mysore—a gift from the Mysore Government.

Work will be conducted in 10 sections: storage and preservation; food surveys and raw materials; dietetics and field studies; food information and statistics; food containers; food adulteration; food sanitation; food processing; food engineering, and biochemistry and nutrition.

CENTRAL DRUG RESEARCH INSTITUTE

Drug research is an integral part of India's health programme. The Central Drug Research Institute is being set up at Lucknow, with five main divisions dealing with chemistry, botany, pharmacology, biochemistry and microbiology and clinical science.

The 'Chattar Manzil' Palace, a gift from the U.P. Government, will house this institute. Remodelling of the building to suit the needs of the Institute is already under way.

CENTRAL ROAD RESEARCH INSTITUTE

Facilities for road research as undertaken in Western countries do not exist in India. Knowledge regarding materials and technique of road construction and its application to improvement of roads in this country is essential.

The proposed Central Road Research Institute will include in its programme of work: study of the technique of construction and maintenance of roads with due regard to the use of indigenous materials;

survey of Indian soils with the object of evolving cheap rural roads; investigation of problems of road safety; development of an improved type of rural vehicle which, while efficient in operation, would be less destructive to rural roads than the existing types.

The Institute is to be located in Delhi, and a site of about 70 acres near the Delhi-Mathura Road, about a mile beyond Okhla railway station, is being acquired for this purpose.

ELECTRO-CHEMICAL RESEARCH INSTITUTE

Research of an applied character with a view to enlarging the production capacity and efficiency of existing industries and fostering new industries based on Indian raw materials will be the main function of the Institute. Provision is also being made for basic and fundamental research.

To start with, there will be two main divisions—Electrolytic and the Electrothermic. In addition, it is proposed to set up ancillary laboratories consisting of analytical, chemical engineering, testing and standardisation and electronic sections.

CENTRAL BUILDING RESEARCH INSTITUTE

A Building Research Unit was set up at Roorkee in 1947 to deal with problems such as construction of low-cost houses and utilisation of cheap construction materials. It is proposed to extend the activities of this unit and establish a Central Building Research Station at Roorkee. Its functions will include: examination of building materials in common use and methods of applying them with a view to effecting economy and improvements; examination of new materials and processes; scientific diagnosis of difficulties and failure of materials in their application; and dissemination of information for the benefit of the building industry.

A STUDY OF THE MICROTONAL VARIATIONS IN FREQUENCIES IN KARNATIC MUSIC

C. S. AYYAR

IN a Conference held in April 1929, South Indian musicologists decided that the 22 srutis of Bharata in Hindu melodic music have the following relative frequencies :—

European notes	Name of note or the swara	Relative frequency	Cyclic cents
C	Sa	1	0
D flat	ri	$\left\{ \begin{array}{l} 256/243 \\ 16/15 \end{array} \right.$	$\left\{ \begin{array}{l} 90 \\ 112 \end{array} \right.$
D	Ri	$\left\{ \begin{array}{l} 10/9 \\ 9/8 \end{array} \right.$	$\left\{ \begin{array}{l} 182 \\ 204 \end{array} \right.$
E flat	ga	$\left\{ \begin{array}{l} 32/27 \\ 6/5 \end{array} \right.$	$\left\{ \begin{array}{l} 294 \\ 316 \end{array} \right.$
E	Ga	$\left\{ \begin{array}{l} 5/4 \\ 81/64 \end{array} \right.$	$\left\{ \begin{array}{l} 386 \\ 408 \end{array} \right.$
F	Ma	$\left\{ \begin{array}{l} 4/3 \\ 27/20 \end{array} \right.$	$\left\{ \begin{array}{l} 498 \\ 520 \end{array} \right.$
F sharp	ma	$\left\{ \begin{array}{l} 45/32 \\ 64/45 \end{array} \right.$	$\left\{ \begin{array}{l} 590 \\ 610 \end{array} \right.$
G	Pa	$\left\{ \begin{array}{l} 3/2 \\ 128/81 \end{array} \right.$	$\left\{ \begin{array}{l} 702 \\ 792 \end{array} \right.$
A flat	da	$\left\{ \begin{array}{l} 8/5 \\ 5/3 \end{array} \right.$	$\left\{ \begin{array}{l} 814 \\ 884 \end{array} \right.$
A	Da	$\left\{ \begin{array}{l} 27/16 \\ 16/9 \end{array} \right.$	$\left\{ \begin{array}{l} 906 \\ 996 \end{array} \right.$
B flat	ni	$\left\{ \begin{array}{l} 9/5 \\ 15/8 \end{array} \right.$	$\left\{ \begin{array}{l} 1018 \\ 1088 \end{array} \right.$
B	Ni	$\left\{ \begin{array}{l} 15/8 \\ 243/128 \end{array} \right.$	$\left\{ \begin{array}{l} 1088 \\ 1110 \end{array} \right.$

the figures in brackets, differing by a frequency ratio of 81/80, a comma, or 22 cyclic cents.

N.B.—For purposes of clarity, the twelve frets of the vina in the octave may be denominated ri, Ri, ga, Ga, Ma, ma, Pa, da, Da, ni, Ni and Sa higher—the capital letters standing for the *swaras* of the Diatonic Scale—Sa being the open *shadja* string, relative frequency being 1, the higher Sa being of rel. freq. 2 or 1200 cyclic cents.

In fixing the above values for the 22 srutis, South Indian musicologists apparently followed the method originally suggested by Helmholtz¹ and recently also advocated by Fox Strangways² and other Western interpreters of Hindu music, of tuning strings by true fourths and true fifths. They also decided in the 1929 Conference that as the *shadja* has been universally adopted as the fundamental for Karnatic melodic music, the 22 srutis may be defined as given below :—

Sa, (R₁ R₂) (R₃ R₄) (G₁ G₂) (G₃ G₄) (M₁ M₂)
(M₃ M₄)
Pa, (D₁ D₂) (D₃ D₄) (N₁ N₂) (N₃ N₄)

R standing for Rishabha, G for Gandhara, M for Madhyama, D for Daivata, N for Nishada since *Shadja* and *Panchama* once decided on, cannot change in melodic music. Thus the 10 frets in the vina, besides Sa and Pa, have been given twin names. They went so far as to give examples *purely subjectively* of the ragas in which the several R's, G's, M's, D's and N's appeared in present-day melodic music, although the ascent and descent of swaras in ragas may continue to be defined by the 12 frets of the vina. To cite one instance, they laid down that *da* of Saveri raga is D₁ and has a relative frequency of 128/81.

Prior to the Conference mentioned above, the writer of the present note had studied the variations of the frequencies with the help of a Sonometer and in a paper, he had shown that there are, in Karnatic music, several prolongable notes in an octave, at which the human voice can stand for a definite length of time and which can be easily produced on the violin without a *gamaka* by means of the bow; and in the same paper he had averred that the *small semitone* as defined by Ellis³ (relative frequency 25/24 above Sa) and the corresponding note above Pa of relative frequency 25/16 are prolongable notes and that, as the voice cannot stand steadily at frequencies 256/243 and 128/81, *gamakas* are produced from the above prolongable notes, as in ri and da of Saveri raga.

From his personal experience in violin play, the author had also reasons to doubt whether the difference in frequency in the 'andolika gamaka' *within the same swara*, viz., i. in Ri of Madhyamavati raga and ii. in Da of Begada raga could only be a comma (rel. freq. 81/80) as would appear from the theory of 22 srutis mentioned above or whether the variation was not much more.

With a view to finding a solution to these questions, the present author had arranged with the National Physical Laboratory, London, in 1933-34, to take photographs of vibration curves of the *gamakas* by means of a Duddell Oscillograph, and for purposes of their measurements, the *gamakas* were played by the writer on his violin according to the standard classical style. Relevant extracts from the Report of the Director of the National Physical Laboratory dated the

12th February 1934, given to the author, in this connection, are reproduced below :—

“The sound from the violin was received by a condenser microphone distant about 2ft. from the violin, and connected through a valve amplifier to one of the vibrators of a Duddell Oscillograph. The wave form of the sound was recorded on photographic paper by means of a revolving drum camera attached to the oscillograph. A time scale was provided on each record by a second vibrator which registered the wave form of the electrical output from a standard valve maintained tuning fork, operating at a frequency of 1000 cycles per second. The player and the receiving microphone were situated in a lagged cabinet so as to avoid as far as possible, any interference from extraneous noise. Communication between the player and the operator of the recording apparatus was maintained by a system of visual signals, controlled by the mechanism of the shutter on the recording camera, the player being warned one second in advance of the opening of the shutter and also at the commencement and conclusion of the exposure. The duration of the exposure was approximately one second in each case.

** ** **

“In all, seventeen records were made,”
(each record measuring 47 cm. C. S.)

etc., as registered by the oscillograph records have been worked out and analysed by a Physicist and a full report about the same is being published elsewhere.

The important results are however, briefly summarised below :—

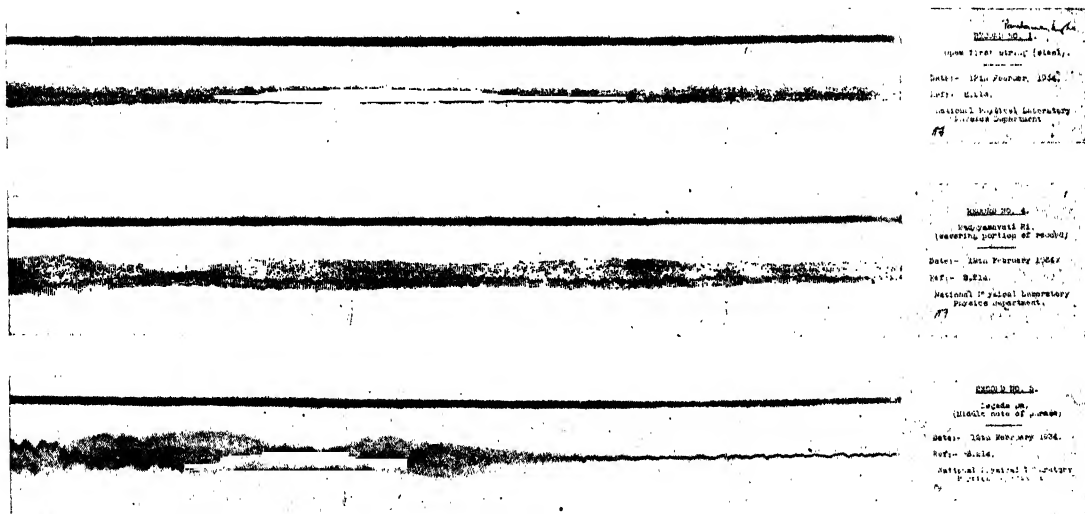
i. In da of Saveri raga, the variation (or gamaka) is from rel. freq. $25/16$ —a small semi tone above Pa—to rel. freq. $8/5$ —a semi-tone above Pa i.e.—a measure of 42 cyclic cents. On analogy, the gamaka in ri of Saveri raga will be from rel. freq. $25/24$ to $16/5$.

ii. The gamaka or variation in Ri of Madhyamavati raga is from rel. freq. $10/9$ —(a minor tone above Sa) to rel. freq. $8/7$ i.e., a measure of 49 cyclic cents.

iii. The gamaka in Da of Begada is from rel. freq. $5/3$ (a minor tone above Pa)—to rel. freq. $12/7$ i.e., a measure of 49 cyclic cents, a ratio of $36/35$ subsisting between $9/5$ and $7/4$.

It is interesting to note that the variations in frequencies within the same swara are *quarter-tones* of definable frequency, which exist between notes arising at certain aliquot parts of the Sa and Pa strings. In (i) above the variation is 42 cyclic cents, while in cases (ii) and (iii) it is 49 cyclic cents.

The above is merely a preliminary study and does not claim to settle finally the important questions relating to the microtonal



The oscillograph records in respect of a few of the interesting gamakas are reproduced below :—

The frequencies of the various gamakas,

variations in frequencies in Karnatic music. It is, however, the considered opinion of the author that these questions can be decided satisfactorily only by *objective*, and not by

subjective, methods. For instance, the author would suggest the frequencies should be actually measured by modern scientific methods similar to those outlined on this note. With a view to avoiding unnecessary controversy, the author would also suggest that the gamakas should be produced for purposes of these experi-

ments by recognised masters of the art of violin play.

1. Helmholtz, "Sensations of Tone-p. 280. Translation" by Ellis. 2. Fox Strangways, "The Music of Hindostan (1914), p. 117 & his article on 'Music' in the *Legacy of India*, p. 311.
3. Ellis, "Helmholtz's Sensations of Tone," pp. 453 and 456.

INDIAN DAIRY RESEARCH INSTITUTE

THE Indian Dairy Research Institute, Bangalore, celebrated its Silver Jubilee last month. The Institute had a very chequered career during its period of existence, and cannot as yet be said to have crossed the final hurdle. It is the youngest of the central institutes devoted to one of the most important branches of applied agriculture, and started its career at Bangalore as Imperial Institute of Animal Husbandry and Dairying in 1923 under the able guidance of the late Mr. William Smith. The main functions of the Institute were to develop foundation herds of important Indian milch breeds, and train personnel in the modern methods of dairy husbandry. Though a Scotsman by birth, Mr. Smith was a lover of Indian cattle, and in spite of many difficulties and obstacles the young Institute had to face, he succeeded in laying a strong foundation, and inspired his staff and students to the noble ideal of service to the cow. The Institute which was functioning as a section of the Imperial Agricultural Research Institute was reconstituted in 1936 into an independent department and the name of the Institute changed to the Imperial Dairy Institute. The question of expansion of the Institute has been engaging the attention of the Government of India for a long time, and a small beginning was made in 1940 by opening a new Imperial Dairy Research Institute at Delhi with the late Dr. Davies as its first Director. Due to various circumstances it was transferred to Bangalore in 1941, and in course of time the two institutes were combined into one under the name of Indian Dairy Research Institute. The proposal to expand the Institute, so that it will be in a better position to render active help to the country's biggest industry, is still under the consideration of the Government of India, and it is hoped that many suggestions that have been made will bear early fruits.

In course of its work the Institute has been able to develop fine pedigree herds of

Gir and Sindhi cows and Murrah buffaloes, and distribute its surplus stock all over the country. The Institute has also an artificial insemination centre which will no doubt contribute a great deal towards the improvement of local stock. The service is gratis, and so far over 3,000 inseminations have been done with striking success.

Another important activity of the Institute is training of personnel in modern scientific methods of dairying. The Institute gives a two years diploma course, called Indian Dairy Diploma, recruiting nearly 35 students every year. In addition there is a short-course especially useful to man in the trade. Honorary workers are also taken for post-graduate work in dairy husbandry, dairy bacteriology, dairy chemistry and dairy technology. There is now a proposal to open a degree course in dairying.

The Institute has been able to develop its scientific sections considerably since 1941 under its able directors Dr. Zal R. Kothavalla and Dr. K. C. Sen. During this short period some interesting and important problems have been tackled. To cite only a few: study of the variation in the quantity and quality of milk due to different feeds and seasons, utilization of different feeding stuffs and bye-products of industries, chemical composition of milk and milk products, freezing point of milk, enzymes and vitamins of milk, composition of ghee, storage properties of butter and ghee, standardisation of methods of manufacture of dairy products, standardisation of chemical and microbiological methods of analysis of milk and milk products, nutritive value of milk and milk products, bacteriological quality of market milk, keeping quality of milk, microflora of dahi and butter, etc., etc.

With this brief description of the manifold activities of the Institute we wish it many useful years of active service for the benefit of our country, and its premier industry—dairying.

CAUSTIC EMBRITTLEMENT OF BOILER PLATE AND RIVET STEEL

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COMPREHENSIVE data exists on the present state of knowledge regarding caustic embrittlement of boiler plate steel. Extensive research work has been done on the subject in America, England and Germany. A review on the work done on the subject is given by Colebeck, Smith & Powell.¹ Parr and Straub² established the main features of this type of embrittlement from which later investigators took their clues. Co-related abstracts of Partridge and Schroeder³ remain the standard of reference down to 1935. These researches have narrowed down the conclusions to two somewhat divergent schools of thought. Both views are, however, in agreement that the caustic embrittlement cracks differ widely from those ordinarily met with in common failures of metals such as fatigue or progressive cracks, fractures produced by direct tension and bending under dynamic and static stresses, etc. The latter cracks are usually transcrystalline, i.e., the path of fracture runs across or through the crystals. Caustic embrittlement cracks in boiler steel are, however, typically intercrystalline following closely the grain boundaries.

The American and British researches have shown that the presence of alkali in the boiler-feed water and stress in the metal are essential for caustic embrittlement failures. Hydrogen absorption in the metal may also play an important part. Obviously no boiler-feed water can, in its normal state, contain enough alkali to cause cracking. The trouble, however, originates at leaky riveted seams and joints when alkaline feed water penetrates and fails to circulate freely thereby causing concentration of alkali due to evaporation of the water in the capillary spaces. As a result concentrated solution and even solid incrustations are formed in the capillaries of the respective joints and seams of boiler plates. A cracked boiler on dismantling reveals strongly alkaline whitish-brown incrustations at the joints between the plates and around the rivets. With the above condition another factor must also be present to cause cracking and that is high stress in the metal. Internal stress result-

ing from cold work through bad-riveting, excessive hammering bending for forming the drums, caulking, etc., is most important.

The stress must also exceed the yield point of the metal. Correcting by force, bad alignment of rivet holes, heavy caulking to ensure parallelism between the edges of the plates, excessive rivetting, pressure and use of improper snap-heads for riveting, etc., all contribute to introduce stress in the metal. Without, however, optimum chemical condition of water, the stress in the metal by itself is unlikely to contribute towards caustic embrittlement. Thus there should be first (1) Leakage in the joints that allows concentration in the capillaries of the boiler seams, (2) An embrittling boiler water and (3) High stress in the metal. Embrittling boiler feed water has been found to contain high alkalinity with low sulphate contents. Boiler Code Committee of A.S.M.E. have recommended ratios of sulphate to alkalinity as a precautionary measure against embrittlement as follows :—

Boiler pressure lbs. per sq. inch	0-150	150-250	over 250
Ratio of sulphate and alkalinity	1	2	3

However, cases of intercrystalline cracking have been recorded in boilers where the above ratios were consistently maintained. Straub and Bradbury⁴ have recommended a sodium sulphate/total alkalinity ratio greater than 1.0 together with sodium chloride/total alkalinity ratio above 0.6 for steam pressure upto 250 lbs. per sq. inch.

The addition of phosphate to the water has not been reported to be effective where the chloride/alkalinity ratio fell below 0.2. Alumina additions have been reported to prevent embrittlement at higher boiler pressures above 500 lbs. per sq. inch. For intermediate boiler pressures of 350 lbs. per sq. inch both the chloride/alkalinity and sulphate/alkalinity ratio and also the ratios expressed by R_2O_3/SiO_2 appear to play an important part in controlling embrittlement.

The second school of thought sponsored by German workers in the field tends to hold the steel responsible for boiler plate failures and claims that to be satisfactory, the steel must be specially resistant to corrosion attack under extreme conditions of temperature and pressure. The paper by Athavale⁵ represents the German Data on the subject claiming that alkali is not the chief cause of the embrittlement but rather the type and quality of steel and the local stresses that are present in the boiler; that caustic embrittlement depends upon hydrogen absorption; and upon precipitation hardening phenomena due to the presence of nitrogen in steel. Germans have recommended the use of Izett non-ageing aluminium steels to prevent cracking.

The above claims have not been substantiated by Americans and British researches. Original German work which was undertaken following a disastrous boilers explosion in 1920, formed the Vereinigung der Grosskesselbesitzer. Their work ignored Parr and Straub's well-established features but emphasized the process of ageing in steel at boilers operating temperatures. Germans Izett non-ageing steel was expected to possess immunity to caustic embrittlement but it was later shown to fail in much the same way as boiler mild steel. Later German results have fallen in line with the results of others.

The term caustic embrittlement is a misnomer just as fatigue cracking is. As pointed out by Desch⁶ the steel between the cracks does not become "brittle" but is merely fissured along the grain boundaries through external influences.

Caustic embrittlement has not been reported from welded or seamless drum boilers owing to complete absence of leaky rivetted joints providing narrow capillary spaces for concentration of alkalis, etc., unless at joints or fittings.

The author has examined a number of cases of caustic embrittlement failures of boiler plates and rivets. The results of some of the typical investigations are discussed below:—

In one case cracks were observed to have started from the rivet hole, extending into the interior of the plate as shown in Fig. 1. Fig. 2 shows the crack starting from the edges of a rivet hole at the joint between

the boiler plates. Evidence of excessive rivetting pressure was left on the boiler plate in the form of deep circular indentations around the rivet holes made by the snap during rivetting as shown in Fig. 2. Deposits of reddish brown scale consisting of magnetic oxide of iron were observed in the crevices and at the contact surfaces of the lap joints from where pittings and several incipient cracks were observed to radiate. The reaction that takes place at the joints is: $-3\text{Fe} + \text{NaOH} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + \text{NaOH} + 4\text{H}_2$.

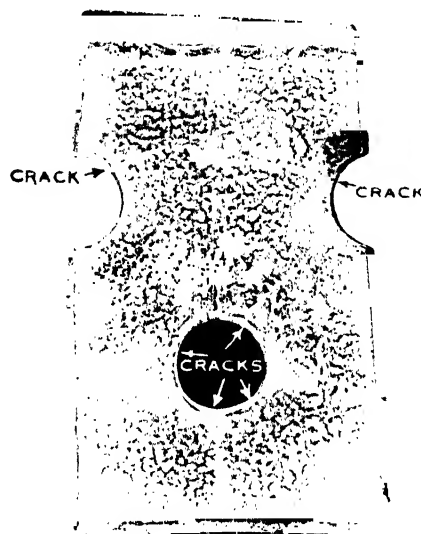


FIG. 1

Cracked Boiler Plate showing caustic embrittlement cracks starting from rivet-hole edge

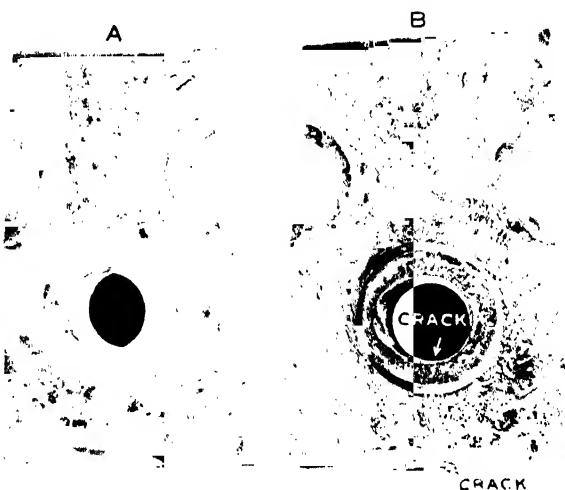


FIG. 2

Cracked Boiler Plate showing fine cracks and deep circular indentations around rivet holes

Samples of boiler feed water gave the following results on chemical analysis :—

	$\frac{\text{Na}_2\text{CO}_3}{\text{NaOH}}$ ratio	$\frac{\text{Na}_2\text{SO}_4}{\text{NaOH}}$ ratio	$\frac{\text{Na}_2\text{SO}_4}{\text{Total alkalinity}}$ expressed as Na_2CO_3
1 Boiler parts taken through glass gauge cock	2.19	0.15	0.78
2 " " "	1.26	1.89	0.28
3 Boiler blow down	0.72	0.61	0.22

Analyses of boiler steel gave the following results :—

Carbon	..	0.18%
Manganese	..	0.56%
Silicon	..	0.105%
Sulphur	..	0.027%
Phosphorus	..	0.035%

Hardness Test.—Hardness values were determined by means of the Vickers pyramid hardness testing machine using 30 kg. load on the surface of the cracked plate starting from the rivet hole edge, at intervals of $1/16"$ apart, with the following results : 138, 136, 135, 139 V.P.H. Nos.

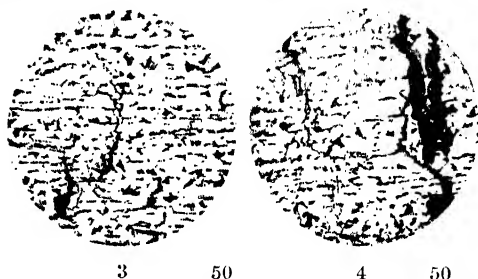
Brinell Hardness test with 3000 kg. load on the surface of the plate $\frac{3}{4}"$ away from the rivet hole gave a value of 137 B.H.N. The approximate tensile strength of the boiler shell plate calculated from the hardness value was about 30 tons per sq. inch.

Bend Test.—Test piece taken from the defective plates away from the cracked area, could be successfully bent through 180° without showing any signs of cracking at the outer surface of the bend.

Macro Examination.—Sulphur Print taken on a longitudinal section of the plates failed to reveal any abnormality. Macro-etching of the same sample showed satisfactory structure. Sulphur Print taken on the longitudinal section of one of the rivets showed freedom from sulphur segregation. On macro-etching some of the rivets, fine circumferential cracks were revealed on the undersurface of the rivet heads near the junction of the shank and head as shown in Fig. 5. Macro-structure of the rivets appeared to be satisfactory.

Microscopic Examination.—Section taken from near the cracked areas of the plate showed the normal fine-grained Sorbo-Pearlite and ferrite structures. Radial cracks starting from the edges of the rivet holes were observed. The main cracks had

considerably opened out through corrosion. Several branching cracks were also observed. The branching cracks were observed in every case to be inter-crystalline as depicted in photo-micrographs Nos. 3 and 4. The main cracks had in most cases extended out to either side of the plate.



FIGS. 3 & 4

Showing micro-structure of the Boiler Plate and inter-crystalline caustic embrittlement cracks



FIG. 5

Circumferential cracks in the boiler rivet at the junction of the shank head—considerably opened out through corrosion

Conclusions.—The results of chemical analysis and physical tests showed that the material of the boiler plate was of satisfactory quality. Macroscopic and micro-examination showed that the material was normal for Boiler quality plates and was free from abnormalities.

The inter-crystalline nature of the cracks starting from the edges of the rivet holes was definitely established by microscopic examination—a phenomenon associated with caustic embrittlement of boiler plates. That there was apparently leakage of water contents of the water in the capillaries of the imperfect and leaky rivet joints where the boiler feed water could not circulate freely, was evident from the deposition of solids at the plate joints and in the crevices. The boiler plate around the rivet-holes had been damaged through bad riveting as depicted in Fig. 2 showing deep circular indentations around the rivet holes made by the snap during riveting. This had

not only damaged the boiler plate, distorted the rivets and the rivet-holes, thereby causing an imperfect and leaky joint to develop but also had left the joints and seams in a state of severe stress—one of the essential causes of caustic embrittlement and cracking of boiler plates at the rivet joints. Such cracking of the boiler plates has always been known to be inter-crystalline in nature and micro-examination of the cracked regions of the boiler plate in the present case corroborated the inter-crystalline failure of the metal. The boiler water, judged from its chemical analysis, was probably not of an embrittling character although the controversy around the chemical analysis of embrittling and non-embrittling types of boiler waters, is still far from settled in the technical literature.

In the present case the caustic embrittlement of the boiler plate appeared probably, to be due to the rivet joints and seams having been in a state of stress by riveting which through damaging the plate, distorting the rivets and rivet-holes, had formed a leaky and imperfect joint. This caused leakage of water and consequent concentration and deposition of the mineral contents of the water and oxides of iron therein at normal boiler temperatures. Due to the same causes, the rivets had also developed cracking as shown in Fig. 5.

Another case of caustic embrittlement of the boiler rivets showed whitish-brown alkaline deposits at the area of contact between the rivet head and the boiler plate as shown in Fig. 6. In this case the rivet-heads were severed off from the shank through caustic embrittlement of the rivets. The chemical composition as well as the quality of the steel of the rivet was quite normal.



FIG. 6

Whitish-brown alkaline deposits at the underside of the rivet heads

Another case of caustic embrittlement cracking of the boiler plate showed the formation of cracks from rivet-holes and whitish incrustation on the plate as depicted

in Fig. 7. The cracks on microscopic examination showed their inter-crystalline nature as shown in Micro-photograph 8. The boiler-plate steel was of sound

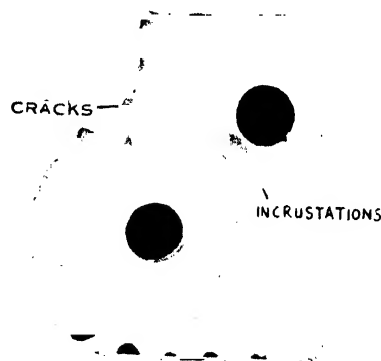


FIG. 7

Showing caustic embrittlement cracks at the rivet holes and whitish incrustations on the plate's surface



FIG. 8

Showing intercrystalline cracking in Boiler Plate owing to caustic embrittlement



FIG. 9

Inter-crystalline cracking in boiler rivets due to caustic embrittlement

XX' shows the path of the crack.

quality and composition, showed freedom from abnormalities on micro and macroscopic examinations and gave very satisfactory physical properties on testing.



Whitish deposits
FIG 10

Whitish alkaline deposits at the rivet head

In another similar case of boiler-rivet failure inter-crystalline cracking and whitish alkaline deposits at the rivet heads are depicted in Figs 9 and 10. The rivet steel itself gave excellent properties on physical and metallurgical tests. Its chemical composition conformed to I.R.S. specification No. M7-39 for boiler quality rivets.

1. Colbeck, Smith and Powell, "Metal Treatment, Winter, 1942-43," **9**, (32), 171. 2. Parr and Straub, *Proc. Amer. Soc. Test. Mat.*, 1926, (26), 52. 3. Partridge and Schroeder, *Metals and Alloys*, 1935, **6**, 145; *Ibid.*, 1935, **6**, 355; *Trans. Amer. Soc. Mech. Engrs.*, 1936 **58**, 223. 4. Straub and Bradbury, *Mech. Eng.*, 1938, **60**, 371. 5. Athavale, *Korrosion und Metallschutz*, 1939, **15**, 73. 6. Desch. J., *Iron and Steel Inst.*, 1941, **143**, 94.

Note.—The cost of printing this contribution has been defrayed by a generous grant from the National Institute of Sciences, India,—*Ed.*

NATURE CONSERVATION AND NATIONAL PARKS

THE concept of nature conservation embraces several distinct purposes such as conservation of plant and animal life, the scientific aspect which includes biological research; field research and experiment; the amenity aspect which deals with æsthetic and recreational side and the educational aspect. The æsthetic and recreational approach placed the main emphasis upon preserving the characteristic beauty of the landscape and upon providing ample access and facilities for open-air recreation and for the enjoyment of beauty in those areas. The major features of the Park are made easily accessible by providing roads, trails and bridges, and living accommodation in the form of hostels, etc. The scientific approach which in no way underestimates the æsthetic values, was primarily directed to the advancement of knowledge and its application to human welfare. "The educational aspect" as the Special Committee on Wild Life Conservation observes "is in many ways complementary to each and all of the others. True appreciation of scenery rests in part upon, and is certainly enhanced by, some understanding of the rocks and the variety of landscape which these induce, the shapes of the rocks and the

variety of landscape which these include, the shapes of the valleys and summits, the flow of the streams, the cliffs and dunes and flats of the coast, and all the rich verdure with which they are clothed, are things which can invigorate and refresh the mind and upon which a deep culture can be based. The more widely this appreciation can be diffused, the sounder will be the mental and physical health of the nation."

The type of areas which are in need of conservation can be classified under the following categories:—

I.—*National Parks and Nature Reserves:* National Parks may be defined as extensive areas of beautiful and relatively wild country with characteristic landscape beauty which are also wild life sanctuaries for the preservation of big game, or other mammals and birds, in which access and facilities for public open air enjoyment are also provided, so that the people may be able to observe wild life of all kinds in its natural surroundings at close quarters. There is also need of nature reserves in the national parks, which act as breeding reservoirs for shy animals, which it is desired to encourage and which are not accessible to visitors.

II.—*Geological Monuments and other areas of outstanding value:* These include rocks, exposures or sections which because of their great geological interest should be preserved as Geological Monuments, and which

* Abstract of Presidential Address delivered by Mr. M. S. Randhawa, before the Section of Botany, 35th Indian Science Congress, Aliahabad, 1949.

should be given the same protection as to archæological buildings and monuments. These should be protected from mining, excavations, prospecting and drilling or similar operations.

III.—*Local Educational Reserves*: These include small areas of local country containing representatives of local flora, which are reserved for educational purposes for the benefit of schools and colleges.

NATIONAL PARKS

Uncontrolled destruction of wild life has been going on in many countries all over the world, and as a result of this natural fauna has dwindled and many species have become extinct. In countries of Western Europe like England the process of death and destruction has reached such limits that the sight of a wild bird or animal is regarded as an event of such importance, that it inspires many lovers of nature to write letters for publication in *Times*, saying that they heard a cuckoo at such and such a place. With the modern means of rapid transport such as motor car, jeep, and aeroplane, the whole world is becoming so speedily opened up to travellers, tourists and traders, and with the increasing population, so much uncultivated land is coming under the settler's plough, that the need for the preservation of fauna in national parks and reserves is being increasingly felt.

National parks and reserves were originally established in the United States of America. There are 26 National Parks in America covering a total area of 1,500 square miles. The first National Park to be established in the U.S.A. was the Yellowstone National Park in 1872.

The lead of U.S.A. has been followed by other countries such as Canada, Australia, New Zealand, and the Union of South Africa. In South Africa, the Sabi Game Reserve was founded in 1898, and in 1926 it was renamed as Kruger National Park. The Albert National Park in Belgian Congo was created mainly due to the efforts of an American naturalist Carl Akeley. Due to the creation of this sanctuary for wild animals the Gorilla has been saved from extinction. The Swiss National Park is about 62 square miles in area, and arrangements are provided in it for enabling the student and tourist to enjoy the more spectacular fauna and flora.

NATIONAL PARKS IN INDIA

In India the necessity of creating National

Parks has found a tardy recognition. Dr. Bainsi Prasad has thus summarised information about National Parks in India:

"In 1934 a very great advance was made in the United Provinces through the great personal interest taken by the enlightened Governor of the Province, Sir Malcolm Hailey, as a result of which the National Parks Act of 1934 was passed. This Act provided for the establishment of National Parks and for the preservation of wild animal life or other objects of scientific interest and for incidental matters provided therein. As a result, the Hailey Park was demarcated as a National Park in the famous Patli Doon and the hill forests to the south of it consisting roughly of an area of 99.07 square miles. Reference may also be made here to the Chamrajanagar Sanctuary of the Mysore State Forests which had been established with a view to offering complete immunity for animals and thereby making it possible for them to thrive without interference. Introduction of other animals not found in the area was to be attempted, and the sanctuary was to provide facilities for the scientific study of the life-histories of different indigenous species of game."

NATIONAL NATURE RESERVES

There is also a clear need of establishing nature reserves within national parks. The principal purpose of such nature reserves is to establish breeding reserves for scientifically encouraging particular species or communities of species the preservation or wider spread of which within the park it is desired to promote. In such reserves public access would have to be more or less restricted.

The authorities who are made responsible for the management of the reserves should keep close touch with University or educational centres, as well as main local natural history societies. A need would also arise of providing small handbooks on nature reserves, explaining with the aid of maps, photographs, and sketches the scientific significance of the reserve.

LOCAL EDUCATIONAL RESERVES

Lack of field training for teachers as well as students is one of the most serious deficiencies in current biological education in India. Without field training or facilities for nature study, teaching of Botany or Zoology tend to become lifeless and warped. Thus here is need of local educational reserves for all colleges where biological sciences are taught. The local Educational

Reserve is the counterpart of the college museum and the laboratory. These reserves would open a vast and a stimulating field of knowledge in a discipline which trains such mental attributes as acute power of observation, patience, concentration, detailed ordering of thought, and the appreciation of form and colour. Visits to these reserves under proper guidance would provide a liberal education to the students in one of the most stimulating and formative fields of thought. These are gains which cannot be quantified in terms of money. A beginning in this direction has been made in Delhi Province, where the local government has placed an area of 20 acres on the 'Ridge' at the disposal of the University of Delhi, Department of Botany. This piece of land will be enclosed with barbed wire, representative trees and shrubs would be labelled and efforts would be made to introduce other local plants also which can grow under these conditions.

NEED OF NEW POLICY

With the liquidation of the feudal order and the merger of states into unions, the problem of wild life preservation has acquired a new significance. Whatever may be the faults of princes and rajahs, it must be said to their credit that they preserved the wild animals and forests of their states rather well. With the growing demands of cultivators who want to save their crops from harmful animals, there is need of clear formulation of policy. There is immediate need of initial survey of all proposed National Parks Areas. While there is necessity of preservation of rich flora and fauna in the National Park Areas, the general wild life policy must be such as will not prejudice the use of developed agricultural land. The interests of the cultivator and the lover of nature must be harmonised. The apprehensions of farmers that National Parks and Nature Reserves will develop into uncontrolled sanctuaries where pests and weeds will be allowed to flourish, and which will spread into surrounding agricultural lands must be allayed. The biologists must give lists of harmful and useful birds and animals. While the friends of the cultivator should be encouraged in the National Parks, the enemies must be exterminated. The biologists should also give a finding whether campaigns should be started for the destruction of wild boars, porcupines,

monkeys, bats and parrots who cause enormous damage to crops and gardens. Before any such campaigns are started, it should be ascertained whether wholesale destruction of certain birds or animals may not have harmful repercussion, elsewhere, on account of the upsetting of balance of power between various organisms. An action which *prima facie* may appear sensible and desirable may have far-reaching and most unpleasant and unforeseen consequences fifty years hence.

NEED OF A CENTRAL BIOLOGICAL SERVICE FOR INDIA

In India also there is need of a Central Biological Service under the Ministry of Agriculture of the Government of India to deal with problems relating to conservation of nature, national parks and fisheries.

The Committee further enumerates the functions of the proposed Biological Service as follows:—

The scientific and practical management and maintenance of the series of National Nature Reserves in such a way as to provide:—

- (i) Reservoirs for the conservation of the main types of wild life (plant and animal species and communities) represented in the country;
- (ii) Facilities for the conduct of fundamental and applied research and survey;
- (iii) Certain educational facilities for students;
- (iv) Facilities for the amateur naturalist and members of the public to observe and enjoy nature.

The Central Biological Service may be co-ordinated with the Indian Forest Service and may form a part of it. It should be staffed by scientists with appropriate qualifications, and should be equipped for survey and research in the field and in the laboratory, with the object of determining the distribution, ecology, genetics, general structure and behaviour of natural populations and physical conditions in which they live. The reserves will be used by the scientists of the Central Biological Service as field laboratories for the study of wild life and its control, and to elucidate the causes which promote or modify the maintenance of the living equilibrium in such areas. In conjunction with the Universities fundamental research on problems of nature conservation

can also be fostered. Best results will, however, be obtained if free flow of staff between the Universities and the Central Biological Service is allowed. This will be of mutual advantage. The scientific workers in Universities will benefit by field experience, while the field workers of the Central Biological Service will maintain contact with problems of fundamental research, and recent advances in research in biological sciences.

PROTECTIVE LEGISLATION

In January 1935, the Government of India convened an All-India Conference for the Preservation of Wild Life at Delhi, with a view to reviewing the position of fauna and flora as it existed at the time and considering generally problem of protection of the animals peculiar to India. The Conference prepared two lists of species, first of animals that were to be protected as completely as possible, and second of those which could only be hunted, killed or captured under a licence, in some cases subject to a bag limit. The Conference further laid stress on the establishment of wild life sanctuaries. It was further recommended that the duty of preserving of fauna should be assigned to forest departments in the areas under their charge, and the necessity of co-operation of police and magistracy was also urged.

A comprehensive protective legislation was enacted in 1933, in the Punjab Wild Birds, and Wild Animals Protection Act.

PROTECTING PLANTS

There is need of protective legislation on the lines of the Punjab Act of 1933 in other provinces also. Moreover the Act should be made more comprehensive and cognizance should be taken of the plant world too. Plants which are rare or striking, beautiful or odd should be scheduled for pro-

tection in areas where this is necessary. Rare plants like species of *Lycopodium*, *Ophioglossum*, and *Osmunda*; and other beautiful plants like *Orchids*, *Rhododendrons* and *Meconopsis*, etc., which are liable to excessive collection by botanists and which are widely plundered and uprooted by 'pleasure' pickers should also be given protection. Their collection should be permitted only under proper control.

PLANT SANCTUARIES IN THE HIMALAYAS

Some of the Himalayan Valleys are in grave danger of losing their character on account of excessive grazing and growth of *Rumex*. Apart from other vegetation, the sheep and ponies which are taken to Alpine meadows above the tree line by graziers in the months of April and May, graze mainly on *Rumex*. A symbiotic relationship has developed between the sheep and *Rumex*. While the sheep feed on *Rumex* in their turn they manure the pasture land with their droppings, which in turn further encourages extensive growth of *Rumex*. The result has been that more attractive, but less edible alpine plants are driven out by *Rumex*, which now covers big areas in Himalayan alpine valleys like that of Pindari Glacier. In the interest of tourist industry, it is very necessary that some of the beautiful alpine Himalayan valleys should be declared as plant sanctuaries; and not only collection of beautiful and rare plants should be controlled, but at the same time, the grazing of sheep and cattle should also be prohibited. This is necessary in the interest of not only tourist industry, but also for checking of soil erosion as well as botanical studies.

Note.—The cost of printing this article has been met from a generous grant-in-aid from the Indian Council of Agricultural Research, New Delhi.

THE INDIAN CHEMICAL SOCIETY

ON the occasion of the celebration of the Silver Jubilee of the Indian Chemical Society in January 1949, Prof. P. Ray, M.A., F.N.I., the President of the Society, delivered a thought-provoking address in which he has raised a number of important issues like the standard of under and post graduate training in science, pure *versus* applied science, the medium of instruction, and multiplication of scientific associations in our country. A Silver Jubilee brochure also was published on the occasion.

THE SILVER JUBILEE ADDRESS

In taking stock of the progress made, Prof. Ray has observed as follows:—

"Looking back upon the past twenty-five years of our existence and making a dispassionate analysis of our achievements and activities, we can discover little justification for complacency or gratification. The standard of our publications has failed to reach the level which we might have not unreasonably expected from the number of

workers in various universities and research institutions of our land."

Though it would prick one's self-pride to the quick, it would be self-deception if one would not agree at least partially with his observation that our activities "have not been of the order that might inspire confidence in a better or brighter future." Such a reckoning at this stage of India's development should urge us open our eyes and work on indefatigably till India would become the torch bearer of world's scientific knowledge. With the present professed sympathy of our Government to matters scientific, it should not be difficult for our leaders of science to instil courage and enthusiasm among the young workers on whose efficient and faithful performance alone will depend the growth and application of future science in India. Opportunities must be created and no pains should be spared to raise the standard of our research work if we consider our present achievements to be below par, so that the country does not lag very much behind advancing fronts of world chemistry.

Prof. Ray has truly said that the basic scientific training in our schools and colleges is far below the standard aimed at. One uniform high standard of teaching and study should be enforced in our universities so that a supply of uniformly qualified band of scientific workers may be assured for the service of the country.

Advocating the need for a harmonious and orderly development of pure and applied sciences, Prof. Ray has said that if India is to take her rightful position in the world of science and render useful service to humanity, she cannot afford to ignore the cultivation of pure science.

Adverting to the question of medium of instruction and expression for science in free India to-day, Prof. Ray has reminded us of the international character of science and its development through the co-operative efforts of all the workers of all the lands through all the ages, and has justly stressed the advantages in retaining the international scientific terminologies nomenclature unchanged and in continuing to use English as the medium for the publication of scientific researches, as well as for discussion in all-India scientific bodies.

One cannot agree totally with Prof. Ray

when he styles the starting of scientific organisations other than the Indian Chemical Society as an unwholesome tendency caused by fissiparous mentality. India is a vast country and can accommodate any number of societies. Perhaps a healthy scientific rivalry among the various organisations pursued on strictly scientific level may further the scientific activity in the country.

THE SILVER JUBILEE BROCHURE (1924-1948)

A perusal of the 35-page Silver Jubilee Brochure gives a bird's eye view of the pursuit of Chemistry in the 19th century as also of the origin and development of Chemical research in India. Although the beginning of the modern school of chemistry in the country is said to date back to 1873 when late Sir Alexander Pedler came to Presidency College, Calcutta, as Professor of Chemistry, the credit of developing the teaching and modern researches in all branches of chemistry would certainly go to late Sir Prafulla Chandra Ray who joined the same institution as a Lecturer in Chemistry in 1889. Sir Prafulla Chandra was undoubtedly the father of modern Chemistry in India. It was due to his efforts that the Indian Science Congress in 1914 and the Indian Chemical Society in 1924 were started. Sir P. C. Ray was the Founder President and Dr. J. N. Mukherjee, the first Secretary of the Indian Chemical Society. During the 25 years of its existence the Society has grown in strength and usefulness. In recognition of its activities, the Society is represented at a number of technical and educational committees. The Society is housed in the University College of Science and Technology, Calcutta. Sir P. C. Ray had made a generous gift of Rs. 10,350 for building a house of its own. Apart from receiving a substantial help from the University of Calcutta, the Society has also been supported by other Indian and State Universities, as also by many research organisations through annual or occasional grants.

The brochure contains short notes about research work carried out in India in the several branches of chemistry. It also contains photographs and life sketches of its Presidents as also the photographs of its Honorary Members.

B. H. IYER,

LETTERS TO THE EDITOR

	PAGE		PAGE
<i>Action of Wood on a Photographic Plate</i> —V. P. NARAYANAN NAMBIYAR ..	284	<i>Estimation of Acetic Acid in Pyroligneous</i> <i>Liquors</i> —P. S. MENE AND U. R. WARHAD- PANDE ..	296
<i>A Note on the Scattering of Light in</i> <i>Plastics</i> —V. P. NARAYANAN NAMBIYAR ..	286	<i>Crisscross Addition to Hydro-Aromatic</i> <i>Ketazines</i> —D. B. DUTT AND P. C. GUHA ..	297
<i>The Raman Spectrum of Cadinenic Ses-</i> <i>quiterpene</i> —V. M. PADMANABHAN ..	287	<i>Embryo Culture to obtain F₁ Plants of In-</i> <i>compatible Crosses in Corn (Maize)</i> — P. UTTAMAN ..	297
<i>An Equation for the Comparison of Sur-</i> <i>face Tensions by Unstable Pendant</i> <i>Drops</i> —K. G. PARVATIKAR ..	288	<i>A Note on the Vegetative Propa-</i> <i>gation of Liliun Longi florum Wall.</i> — P. KACHROO ..	299
<i>The Millerian Direct Sine Formula</i> <i>and the Converse Cotangent Formula</i> —P. R. J. NAIDU ..	288	<i>A Note on the Micro-Organisms Present</i> <i>in Date-Palm Juice (Sendhi)</i> —MOHAN BABU NAIDU AND J. LAKSHMIKANTHAM ..	299
<i>Berek's Compensater</i> —P. R. J. NAIDU ..	289	<i>Proliferation of Spikelets in Pennisetum</i> <i>Polystachyum, Schult</i> —C. RAJASEKHARA MUDALIAR AND D. DANIEL SUNDARARAJ ..	301
<i>Magmatic Water in Chalcedony and Agate,</i> <i>Bhera Ghat, Jubbulpore District, Central</i> <i>Provinces</i> —H. L. CHIBBER ..	290	<i>Rain of Prawns in Siam</i> —B. SUNDARA RAJ ..	302
<i>Electrolytic Preparation of Azo-Dyes. III.</i> <i>Dye Formation at an Iron Anode</i> — M. V. SITARAMAN AND V. V. RAMAN ..	291	<i>Anti-Histamine Activity of Substituted Ben-</i> <i>zhydryl Amines</i> —(MRS.) RANITA AIDMAN AND M. B. GHARPURE ..	303
<i>Surface Tension of Solutions of Cetyl</i> <i>Pyridinium Bromide</i> —B. K. BANERJI ..	292	<i>Processes of Separation Involving Dialysis</i> — S. L. SASTRY ..	305
<i>Adverse Effect of Mixing Tapioca and</i> <i>Sweet Potatoes in Wheat Flour</i> —P. N. AGARWAL ..	294	<i>Gestation in the Oriental Vampires</i> — P. A. RAMAKRISHNA ..	307
<i>Attempts towards the Synthesis of Sub-</i> <i>stituted Polyguanides</i> —P. R. GUPTA AND P. C. GUHA ..	294		

ACTION OF WOOD ON A PHOTO-
GRAPHIC PLATE

WOOD possesses the very interesting property of acting on a photographic plate in total darkness and registering clearly a picture of it thereon. This property of wood was studied in some detail by Russel,¹ who experimented with a number of European timbers and classified them from the standpoint of their relative activity on a photographic plate. A similar investigation in regard to Indian timbers seemed desirable. For this purpose a very wide variety of Indian timbers was selected. The specimens were mostly rectangular in shape and their broad faces were carefully planed and rendered perfectly smooth. Each specimen

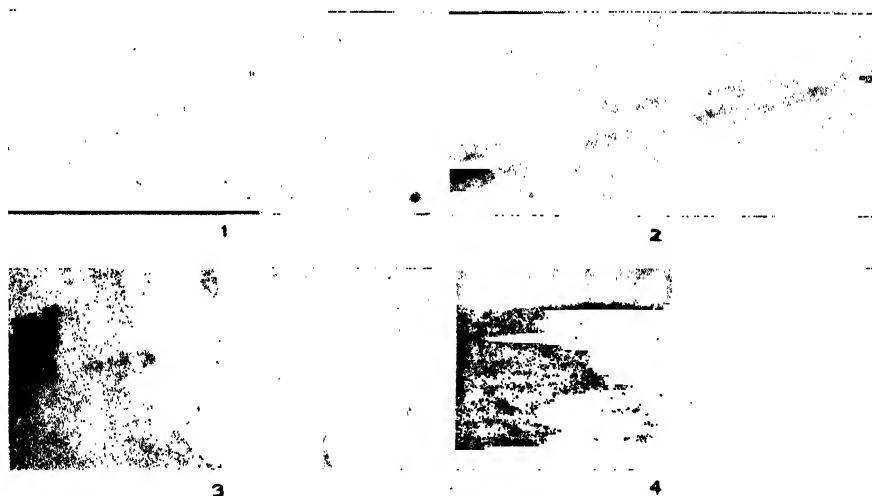
was then placed with one of its smooth faces in contact with the sensitive side of a photographic plate (Ilford Special Rapid) in a dark room and the wood and the plate were wrapped completely in a thick black paper, and placed in a cardboard box. The box itself was placed in a bigger light tight box, and the latter was carefully wrapped in black cloth.

To start with, exposures ranging from 30 minutes to about 18 hours—those tried by Russel and found to give satisfactory results in the case of European timbers, were tried. The plates were developed in the usual way, but surprisingly enough, the results were negative, there being practically no perceptible action during the period on the type of photographic plate used. Thereupon longer

exposures including extremely long ones, ranging from 48 hours to about 72 hours, were tried. It was not till prolonged exposures varying from 48 hours to 72 hours were given that the specimen was found to register a clear picture on the plate. This was found to be generally the case, with all the species of timbers subjected to investigation. Indian timbers therefore seem to be comparatively slower from the point of view of their photographic activity than their European counterparts, the most inactive of which did not, according to Russel, require more than 18 hours exposure for satisfactory results. It is however likely that the photographic material used by Russel was faster. Photograph 1 shows the picture obtained with a block of rose-wood (*Dalbergia lati-*

exposed directly to sunlight. Though the effect of ultra-violet radiations does not seem to have been investigated by Russel, the other results are similar to those obtained by him. Photograph 2 represents the picture obtained in the case where the left half of the specimen was exposed to the action of ultra-violet radiation and the right half was covered with thick black paper. The difference between the two portions and the demarcating line between them are distinctly noticeable.

The activity was much more pronounced in the case of white-cedar (*Dysoxylum malabaricum*) which gave a distinctly darker picture than teak (*Tectona grandis*). Photo-obtained. The left white portion represents the region acted upon by white cedar and



folia). The time of exposure was 72 hours.

The action of sunlight, the relative influence of the different parts of the spectrum and the effect of ultra-violet radiation on the photographic activity of the specimen, were next investigated. The piece of wood was half covered with thick black paper and exposed to the source of light for 10 minutes. It was then put in the usual way in contact with a photographic plate. The plate when developed was found to give a dark picture in the region where the light fell and only a faint picture of the part which was kept unexposed. Light therefore has the distinct effect of increasing the photographic activity of wood. It was further found that the part covered by the red filter was least active and that by the blue filter most—the activity in the latter case being almost the same as if that part was

the right dark picture is that due to teak-wood.

If, as was suggested by Russel, the action exerted on a photographic plate was really due to the presence of hydrogen peroxide produced by the resinous bodies present in the wood, the elimination of such bodies must arrest the activity. One of the specimens was therefore placed in a mixture of benzene and alcohol and allowed to stand in it for over three days. The resinous bodies, being soluble in the mixture, were extracted by the solvent from the wood. The specimen was then put in contact with a photographic plate in the ordinary way but it was found on development that the wood had practically ceased to be active. It therefore seems true that the resinous bodies present in the wood are responsible for its photographic activity. Whether the activity is

really due to the presence of hydrogen peroxide, as suggested by Russel, remains a moot point which requires to be further investigated. Experiments in this direction are now in progress. Photograph 4 shows the pictures obtained with two blocks of wood one inch square cut from the same specimen of teak. One of them (right half) was placed in a mixture of benzene and alcohol as described above and the resinous bodies extracted. The picture registered by it was extremely faint and almost imperceptible.

Further experiments with different species of Indian timbers are now in progress. Details will be published elsewhere.

Department of Physics,
Pachaiyappa's College,

Madras, V. P. NARAYANAN NAMBIYAR.
May 28, 1949.

1. Russel, W. J., *Proc. Roy. Soc.*, 1897, 61, 424-33.

A NOTE ON THE SCATTERING OF LIGHT IN PLASTICS

THE study of the molecular structure, constitution and properties of plastics, has been the subject of extensive experimental investigation.

There are today innumerable varieties of plastics at present in everyday use in industry. Of the different types so far manufactured, some, at any rate, are remarkably clear and transparent and very definite in their optical properties. It occurred to the author that a study of the scattering of light in such specimens could with success be undertaken to unearth useful information regarding the molecular structure and constitution of the specimen. With this object in view the present work was undertaken.

The plastics selected for the present investigation is the popular variety, commercially known as 'Perspex' (Unplasticised). 'Perspex' [methyl methacrylate $\text{CH}_2=\text{(CH}_3\text{)COOCH}_3$] is the registered trade name for the acrylic resin sheets and blocks manufactured and sold by the Imperial Chemical Industries, Limited, and possesses an outstandingly high degree of light transmission in all wave-lengths throughout the visible range. This substance is very steady at ordinary temperatures and possesses very definite physical properties. Some of its physical constants already determined,¹ are reproduced in Table I.

TABLE I

Specific gravity at 20° C.	..	1.19
Refractive index for the 'D'		
line at 20° C.	..	1.4900
Softening point	..	105° C.
Thermal conductivity	..	3.5×10^{-4} c.g.s. unit
Coefficient of expansion	..	$80.0 \times 10^{-6}/^\circ \text{C.}$
Specific heat		0.35

The specimen selected was in the form of a cube of about 1 inch in size with perfectly plane and polished surfaces.

The specimen under experiment was kept immersed in dust-free distilled water contained in a rectangular cell. The cell was suitably blackened on the outside excepting for three windows. Sunlight was used as the source of illumination. The factors of depolarisation ρ_u , ρ_v , and ρ_h with the incident light respectively unpolarised, and vertically and horizontally polarised, were determined by the usual Cornu method.² Suitable precautions were taken to eliminate or minimise all sources of incidental error.

The results of the investigation are given in Table II. The fourth column in the table gives the value of ρ_h calculated from the observed values of ρ_u and ρ_v applying the

$$\text{general Reciprocity relation } \rho_u = \frac{1 + \frac{\rho_h}{\rho_v}}{1 + \frac{1}{\rho_v}}$$

The agreement between the calculated and the observed values of ρ_h is quite satisfactory. $\Delta \rho_u$ in the last column is the difference between the observed value of ρ_u and the anisotropic part of ρ_u which may, to a first approximation, be considered as equal to $\frac{2\rho_v}{1+\rho_v}$. This is a function of the size of the scattering centre.³

TABLE II

ρ_u	ρ_v	ρ_h		$\Delta \rho_u$
		Observed	Calculated	
9.3%	4.5%	84.0%	86.5%	0.68%

From an analysis of the results, the following conclusions can be drawn:—

(1) The low value of ρ_u suggests that the light scattered by the specimen is strongly polarised.

(2) It is found that the value of ρ_h is less than 100%. This furnishes positive

evidence for the existence of molecular aggregates in 'Perspex', the size of which is not excessively small compared with the wave-length of light.

(3) The value of ρ_v (4.5%) is a measure of the optical anisotropy of the scattering molecules.

(4) $\Delta\rho_u$ represents the depolarisation due to the finite size of the scattering centres, and can consequently be regarded as a function of the size of the scattering centre. The low but definite value of $\Delta\rho_u$ suggests that the molecular aggregates are not of large size.

(5) The calculated value of $\Delta\rho_u$ is found to be 0.68%. This compares favourably with the order of the value of $\Delta\rho_u$ obtained by Krishnan for optical glasses.⁴ The molecular aggregates in 'Perspex' therefore, seem to be approximately of the same size as those in optical glasses.

Further experiments with other varieties of plastics are in progress. Details will be published elsewhere.

The author is grateful to Messrs. Mehtalia Plastics, Madras, for the specimens of plastics they were good enough to supply him for the purpose of this investigation.

V. P. NARAYANAN NAMBIYAR.

Department of Physics,
Pachaiyappa's College, Madras,
June 7, 1949.

1. *Plastics Technical Bulletin*, February 1944, No. 10 (Imperial Chemical Industries, Limited),
2. Krishnan, R. S., *Proc. Ind. Acad. Sci.*, (A), 1935, **1**, 915-17. 3. — and Venkat Rao, P., *Ibid.*, 1944, **20**, 109-16. 4. —, *Ibid.*, 1936, **3**, 212-20.

THE RAMAN SPECTRUM OF CADINENIC SESQUITERPENE

ALTHOUGH numerous investigations on the Raman spectra of terpenes have been made,

the studies on sesquiterpenes are comparatively few. Mr. Sukh Dev Lala (1948) of this Institute has isolated a dextro-rotatory cadinenic sesquiterpene from the essential oil of *Hardwickia pinnata* and has very kindly placed the sample at the disposal of the author for the investigation. By means of ozonolysis and dehydrogenation he has come to the conclusion that this compound is a structural isomer of α -cadinene, and is a mixture of two isomeric hydrocarbons. It appeared desirable to study its Raman spectrum with a view to get some information concerning its constitution.

The Raman spectrum obtained by using λ 4358 of the mercury arc as exciting radiation is reproduced in Fig. 1. The spectrum exhibits a series of 53 distinct frequency shifts.

104, 142, 183, 282, 310, 330, 366, 390, 428, 468, 485, 515, 530, 565, 588, 625, 667, 691, 707, 743, 763, 781, 818, 848, 875, 399, 909, 935, 959, 988, 1028, 1055, 1115, 1160, 1191, 1220, 1254, 1294, 1313, 1328, 1377, 1440, 1462, 1615, 1648, 1678, 2823, 2865, 2893, 2925, 2966, and 3044 cm^{-1} . The appearance of a fairly large number of frequency shifts in the Raman spectrum may be attributed to the complexity of the sesquiterpene under investigation. Some characteristic features of the spectrum may be mentioned. Of the five intense lines, (1648, 1678, 1440, 2855 and 2920 cm^{-1}), 2855, 2920 and 1440 are characteristic of the decaline ring present in the sample. The two intense lines 1648 and 1678 cm^{-1} are evidently due to C=C linkage. Comparing the frequency shifts of these lines with those due to C=C linkage appearing in other terpene compounds such as Sabinene, Limonene, Carvomenthane, and Sylvestrene, it may be inferred that these lines are due to the presence of one internal and one external C=C linkage. Lines with frequency shifts less than 200 cm^{-1} may be

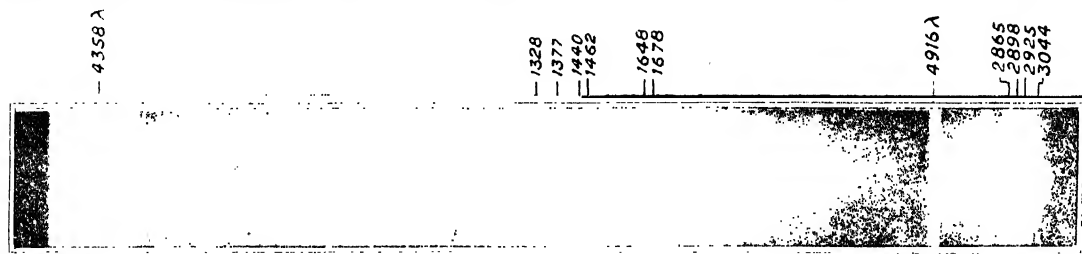


FIG. 1. Raman spectrum of a dextro-rotatory cadinenic sesquiterpene isolated from the essential oil of *Hardwickia pinnata*.

attributed to deformation oscillation of the benzene rings against each other. Further discussion of the results is not possible at present for want of data concerning the Raman spectrum of cadinene.

Physics Department, V. M. PADMANABHAN.
Indian Institute of Science,
Bangalore,
August 2, 1949.

1. Sukh Dev Lala, "Thesis for Ph.D.," East Punjab University, 1948.

AN EQUATION FOR THE COMPARISON OF SURFACE TENSIONS BY UNSTABLE PENDANT DROPS

WORTHINGTON¹ has shown that whatever the liquid, if the quantity $\beta = 2b^2/a^2$ (where b is the radius of curvature at the apex, and a^2 is the capillary constant) is the same for two drops coming from tips of different radii r_1 and r_2 , then the conditions for similar shape of the two drops are that

$$\frac{2b_1^2}{a_1^2} = \frac{2b_2^2}{a_2^2}.$$

When drops have similar shape, all corresponding linear dimensions of the two drops will be proportional to one another so that

$$\frac{b_1}{b_2} = \frac{a_1}{a_2} = \frac{r_1}{r_2}$$

and for a given shape, the equatorial diameter de of a drop is proportional to b .

$$\text{i.e., } \frac{b_1}{b_2} = \frac{\frac{de_1}{r_1} \times r_1}{\frac{de_2}{r_2} \times r_2} = \frac{de_1}{de_2}, \quad (i)$$

where the subscripts 1 and 2 refer to similar drops of two different liquids. Recently R. C. Brown and H. McCormick² in considering the detachment of drops from a conical tip, have shown that, provided the angle of contact between the liquid and the surface of a conical tip is the same, all drops forming on a cone of given angle are similar in shape at the unstable stage. The condition of constant contact angle is, of course, achieved in practice by ensuring that the angle is zero, i.e., that the liquid wets the tip.

Therefore for a given shape (say S)

$$\beta = \frac{g \sigma_1 b_1^2}{\gamma_1} = \frac{g \sigma_2 b_2^2}{\gamma_2},$$

where σ_1 and σ_2 are the effective densities and γ_1 and γ_2 are the surface tensions of the two liquids respectively.

$$\text{i.e., } \frac{\gamma_1}{\gamma_2} = \frac{\sigma_1 b_1^2}{\sigma_2 b_2^2}$$

and using equation (i),

$$\frac{\gamma_1}{\gamma_2} = \frac{\sigma_1 de_1^2}{\sigma_2 de_2^2}. \quad (ii)$$

Equation (ii) permits one to calculate the ratio of surface tensions of two liquids, if it is possible to photograph hanging drops at the unstable stage.

This work arose as a result of my similar experimental investigations on surface tension problems under the direction of Dr. N. R. Tawde of this Institute to whom I offer my grateful thanks.

Physics Department,
Royal Inst. of Science, K. G. PARVATIKAR.
Bombay,
June 22, 1949.

1. Worthington, *Proc. Roy. Soc.*, 1881, 32, 332.
2. Brown, R. C., and McCormick, H., *Phil. Mag.*, 1948, 39, 420.

THE MILLERIAN DIRECT SINE FORMULA AND THE CONVERSE COTANGENT FORMULA

THE Millerian Direct Sine Formula

$$\frac{\sin AB}{\sin AC} \times \frac{\sin DC}{\sin DB} = \frac{h'k'l'}{hkl} \times \frac{p'q'r'}{pqr}$$

and its converse cotangent equivalent, $p \cot AB - q \cot AC = (p - q) \cot AD$ (for anharmonic cases) and $\cot AB + \cot AD = 2 \cot AC$ (for harmonic cases) is without

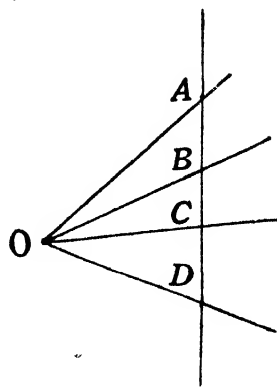


FIG. 1

proof in text-books of crystallography, possibly because it is simple. Tutton¹ remarks, "it is readily capable of proof"

Barker² remarks, "Miller showed that the four sines of the above formula can be rearranged into another from involving cotangents." Since 1933, I have been giving the following proofs to my classes in crystallography. Let OA, OB, OC and OD be a zone sheaf intersected by a fifth zone ABCD forming a cozonal quartette.

$$\text{Then } \frac{AB}{OB} = \frac{\sin AOB}{\sin OAB} \quad (1)$$

$$\frac{AC}{OC} = \frac{\sin AOC}{\sin OAC} \quad (2)$$

$$\frac{DC}{OC} = \frac{\sin DOC}{\sin OCD} \quad (3)$$

$$\text{and } \frac{DB}{OB} = \frac{\sin DOB}{\sin OBD} \quad (4)$$

Dividing (1) by (2) and (3) by (4), and multiplying the quotients and cancelling common factors, we get $\frac{\sin AB}{\sin AC} \times \frac{\sin DC}{\sin DB} =$

$\frac{AB}{AC} \times \frac{DC}{DB}$. The right side of the equation is the

geometrical analogue to $\frac{hkl}{pqr} \times \frac{p'q'r'}{h'k'l'}$ of the

sine formula, the identity of which with the ratios of the sines of the angles requires a very elaborate proof and is lucidly stated by the Cambridge crystallographer, Prof. C. Lewis.³

If we express the left side of the sine formula as $\frac{\sin AB}{\sin AC} \times \frac{\sin (AD-AC)}{\sin (AD-AB)}$ thereby eliminating DC and DB, and put the product of the right side of the equation = $\frac{d}{q}$,

then by expanding the left side and dividing it by $\sin AB \sin AC \sin AD$, we get,

$$\frac{\cot AC - \cot AD}{\cot AB - \cot AD} = \frac{p}{q},$$

which by cross-multiplication and transposition becomes $p \cot AB - q \cot AC = (p - q) \cot AD$. In harmonic cases the value $\frac{p}{q} = \frac{1}{2}$; substituting $p=1$ and $q=2$ in the above formula and transposing, it simplifies to

$$\cot AB + \cot AD = 2 \cot AC.$$

Mysore University, P. R. J. NAIDU.
Central College,
June 27, 1949.

1. Tutton, A. E. H., "Crystallography and Practical Crystal Measurement," 1922, 1, p. 89.
2. Barker, T. V., "Graphical and Tabular Methods in Crystallography," 1922, p. 61.
3. Lewis, W. J. "Crystallography," 1899, pp. 87-93.

BEREK'S COMPENSATER

In a note on Berek's compensater,¹ a correction was made that $\log f(i)$ values should be used instead of $\log(i)$ values. The $\log f(i)$ values are computed from the formula of Berek:—

$\log f(i) = \log \sin^2 i \{1 + .2040 \sin^2 i + .0627 \sin^4 i\}$. Substituting the values of (i) , in the case of hypersthene, viz., 14.55° and 24.95° in the equation, it is seen that the values of $\log f(i)$ for these angles correspond to 8.806 and 9.266 as given in the tables. The proof of this correction factor is given, after Berek,² as follows:—

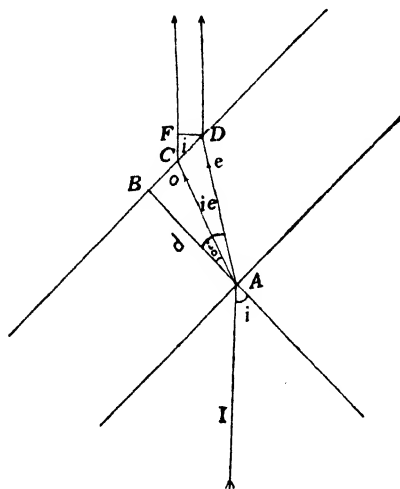


FIG. 1

The incident ray (I) is refracted in the calcite plate into the rays o and e , which on emergence from the plate, are parallel; and at the point D, o has travelled the distance $AC + CF$, and e the distance AD . Therefore,

$$\Gamma = \frac{AC}{\lambda_1} + \frac{CF}{\lambda} - \frac{AD}{\lambda_2} \quad (1)$$

If d be the thickness of the plate

$AC = \frac{d}{\cos i_0}$; $AD = \frac{d}{\cos i_e}$; $CF = d (\tan i_e - \tan i_0) \sin i$. We also know that $\omega \lambda_1 = \epsilon_1 \lambda_2 = \lambda$, and $\omega \sin i_0 = \epsilon_1 \sin i_e = \sin i$. Substituting these values in (1) above, we have,

$$\Gamma = \frac{\omega d}{\lambda \cos i_0} + \frac{d}{\lambda} \left(\frac{\epsilon_1 \sin^2 i_e}{\cos i_e} - \frac{\omega \sin^2 i_0}{\cos i_0} \right) - \frac{\epsilon_1 d}{\lambda \cos i_e} - \frac{d}{\lambda} (\omega \cos i_0 - \epsilon_1 \cos i_e). \quad (2)$$

But we know from the index ellipsoid of a uniaxial crystal that $\frac{1}{\epsilon_1^2} \cos^2 i_e + \frac{\sin^2 i_e}{\omega^2} = \frac{1}{\epsilon^2}$, and that $\epsilon_1^2 \sin^2 i_e = \sin^2 i$. From these two relationships, it is proved that $\epsilon_1^2 \cos^2 i_e = \omega^2 \left(1 - \frac{\sin^2 i}{\epsilon^2} \right)$ and that $\omega^2 \cos^2 i_0 = \omega^2 \left(1 - \frac{\sin^2 i}{\omega^2} \right)$. Inserting these values in (2) above, we have,

$$\Gamma = \frac{d}{\lambda} \omega \left(\sqrt{1 - \frac{\sin^2 i}{\omega^2}} - \sqrt{1 - \frac{\sin^2 i}{\epsilon^2}} \right).$$

Solving this last expression by the binomial theorem, we get,

$$\Gamma = \frac{d\omega}{2\lambda} \left(\frac{1}{\epsilon^2} - \frac{1}{\omega^2} \right) \sin^2 i \left\{ 1 + \frac{1}{4} \left(\frac{1}{\epsilon^2} + \frac{1}{\omega^2} \right) \sin^2 i + \frac{1}{8} \left(\frac{1}{\epsilon^4} + \frac{1}{\epsilon^2 \omega^2} + \frac{1}{\omega^4} \right) \sin^4 i + \dots \right\} \quad (3)$$

Inserting the values of ϵ and ω of calcite, the expression within the $\{ \dots \}$ bracket in (3) above simplifies into $\sin^2 i \{ 1 + .2040 \sin^2 i + .0627 \sin^4 i \}$, which is the factor indicated as $f(i)$ in the tables; and the first part of (3), i.e., $\frac{d\omega}{2\lambda} \left(\frac{1}{\epsilon^2} - \frac{1}{\omega^2} \right)$ is indicated as constant C in the tables. Both these values can therefore be calculated, if the tables are lost.

Central College,
Mysore University,
June 22, 1949.

P. R. J. NAIDU.

MAGMATIC WATER IN CHALCEDONY AND AGATE, BHERA GHAT, JUBBULPORE DISTRICT, CENTRAL PROVINCES

THE author came across very interesting nodules of chalcedony and agate containing magmatic water while touring the interesting and celebrated area of the Marble Rocks of Bhera Ghat in the Jubbulpore District of the Central Provinces. So far he is aware of no such instance has been recorded from India before. It has been, therefore, deemed advisable to place it on record. He came across a nodule of chalcedony, about $1\frac{1}{4}$ inches in size and with the maximum thickness of half an inch. One side of the nodule was convex in shape, while the other side was plane. It was observed to contain magmatic water which appeared to move inside the nodule when it was rotated. At first it was taken for some light effect. But on breaking the nodule it was found to contain water which splashed on all sides. Inside the nodule a cavity or rather a fine geode was observed, which measured three-fifths of an inch in width and one-fifth of an inch in height. Fine crystals of quartz, slightly bluish in tinge, were found lining the cavity. The trapped water was apparently a hydrothermal solution containing silica, which was responsible for the crystallisation of quartz inside the fine geode.

On enquiry the author was informed that such nodules of chalcedony and even agate are commonly found in the bed of the Narbada. A search for such nodules containing water is made by the local people in the bed of the stream. These are cleaned and somewhat polished in order that the enclosed water becomes visible, particularly on rotating the nodule. Occasionally, large nodules are found which may contain one tola or two-fifths of an ounce of such magmatic water. Such nodules are purchased by the pilgrims and other tourists as souvenirs from the Narbada at Bhera Ghat. It would be interesting to recover the trapped magmatic water and analyse it chemically.

The origin of this magmatic water is definitely connected with the igneous activity which was responsible for the intrusions of the basic dykes in the marble rocks. On microscopic examination these dykes have proved to be of olivine gabbro, quartz-hypersthene-biotite-gabbro, and epidiorite. These dykes appear no doubt to be the

1. Curr. Sci., Feb. 1949, 18, No. 2, 43 and Ibid., Apr. 1949, No. 4, 141. 2. von Dr. M. Berek, "Mikroskopische Mineralbestimmung mit Hilfe der Universal drehtische methoden," 1924, 133-36.

hypabyssal representatives of the Deccan Trap flows of which occur near Jubbulpore and also across the Narbada near Tilwara Ghat. It appears that the hydrothermal phase of this igneous activity was represented by the water containing silica in solution. It deposited silica as quartz, chalcedony, agate, opal, jasper, etc., in the form of intricate veins and patches so commonly observed in the dolomitic marble. On weathered surfaces of the marble the beauty and the intricacy of the patterns of this silica becomes clear.

With regard to these nodules it appears that the crystallisation of this silica begins from the exterior and sometimes as a result of rapid chilling the solution gets entrapped which for sometime lays a deposit of crystals of quartz, fine or large according to the size of the cavity and the amount of solution enclosed.

The author¹ has published already an account of the occurrence of magmatic water in the Deccan Trap.

Benares Hindu University, H. L. CHHIBBER.
May 27, 1949.

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 2. —, *Proc. Ind. Sci. Cong.*, 1945.

ELECTROLYTIC PREPARATION OF AZO-DYES. III. DYE FORMATION AT AN IRON ANODE

AZO-DYES are formed at the anode in an electrolytic cell but only with low yields. The probable reasons for this have been discussed in an earlier communication¹ and can be seen to be unavoidable under the circumstances. It was therefore considered worthwhile to try to improve the yield of the dye by other methods, or at least to try to get this method of preparing azo-dyes to be practicable in some way or other. One step that suggests itself is the elimination of platinum as anode material. If this were done, the advantage gained would be two-fold. Firstly, the use of an expensive metal is avoided. Secondly, nitrites are oxidised to nitrates at a platinum anode, especially when the alkalinity of the anolyte is low.² While it has been observed that the presence of nitrate ion is not harmful in itself, it would certainly be reasonable to take care to see that as little of the nitrite taken is oxidised especially in view of the fact

that the dye formation proceeds better on prolonged electrolysis.

The platinum anode could therefore be replaced profitably by an anode which is in the first place quite cheap and secondly is a poor oxidiser for nitrite. The materials that satisfy the first condition are carbon, iron and nickel. Iron and nickel also satisfy the second requirement for nitrite is oxidised with a very low efficiency at anodes of iron and nickel.

A series of experiments carried out with these materials showed that only iron was suitable for use as anode. It was found that carbon anodes disintegrated badly, though some dye formation took place. Nickel anodes also had to be rejected, since extensive tar formation occurred, and the formation of the dye was very poor. Iron had none of these defects and was corroded only to a negligible extent, particularly when a heavy sheet was used, with the corners and edges rounded off by filing.

Several dyes were prepared by electrolysis of the proper components at an iron anode. The yields obtained were comparable to those obtained at a platinum anode, and in some instances slightly better.

EXPERIMENTAL

The cell used in this series of experiments was of the divided type, a porous alundum cup forming the cathode chamber and diaphragm. The anode was of heavy sheet iron, with the edges and corners rounded by filing. This anode was cleaned, heated to redness and chilled in water before being used, as the reaction was found to be unsatisfactory without this treatment. It would perhaps be better to refer to this anode as an iron oxide anode; the thin layer of oxide formed might help the passivation of the anode. The entire arrangement was kept in a 400 c.c. Pyrex beaker, which formed the anode chamber. A glass propeller type stirrer was used for stirring.

Roccelin: 3.06 gm. sodium naphthionate, 1.80 gm. β -naphthol, 0.87 gm. sodium nitrite and 0.50 gm. sodium hydroxide, in 150 c.c. of water were electrolysed for 20 minutes at a current density of 5 amps./dm.² The anolyte was coloured a deep red. The dye was salted out by carefully adding 20 gm. of sodium chloride with good stirring. The precipitated dye was filtered at the pump, washed with dilute sodium chloride solution, sucked as dry as possible and dried in the air-oven. A dark red powder that was indis-

tinguishable from the dye obtained at the platinum anode was got. Silk dyed with this sample had a good colour. Yield of dye: 1.10 gm. or 22% of the theoretical.

Orange II: This dye was also formed in a satisfactory manner at an iron anode. 2.50 gm. sulphanilic acid, 1.80 gm. 6-naphthol, 0.50 gm. sodium hydroxide, and 1.00 gm. sodium nitrite, in 150 c.c. of water were electrolysed for the theoretical length of time, at a current density of 5amps./dm.² The dye was recovered as the barium salt. Yield of dye: 1.48 gm. or 29.6% of the theoretical.

On passing the current for thrice the theoretical length of time, a better yield of dye was obtained: 3.07 gm. or 61.4% of the theoretical.

Ponceau G: This dye was obtained by the electrolysis of molar proportions of aniline, 2-naphthol-3, 6-disulphonic acid (disodium salt) and sodium nitrite in an alkaline electrolyte. The dye was formed in very poor amounts in neutral medium. 4.35 gm. R-salt, 1.16 gm. aniline, 0.90 gm. sodium nitrite and 0.50 gm. sodium hydroxide, in 150 c.c. of water were electrolysed at a current density of 5 amps./dm.² for 20 minutes. The anolyte had a bright red colour. The dye was recovered from the anolyte by salting out. The precipitated dye was filtered at the pump, dried and weighed. Yield of dye: 1.15 gm. or 20.3% of the theoretical. The colour on silk and wool was bright and of a good shade.

On passing the current for thrice the theoretical time, the yield of dye improved, and amounted to 3.4 gm. or 60.2% of the theoretical. The current efficiency is seen to be the same, that is, 20%.

Ponceau 2R: This dye could also be prepared by the electrolytic method using an iron anode. In this case, a study was made of the effect of factors like the addition of sodium nitrate, the change in the alkalinity of the anolyte and prolonged electrolysis. The formation of the dye at a platinum anode under what appeared to be the most favourable conditions was also studied. The results are summarised in the table below. 4.35 gm. R-salt, 1.50 gm. *m*-xylydine and 0.90 gm. of sodium nitrite were electrolysed in 150 c.c. of water, with the modifications mentioned above, at an iron anode. The current density was 5 amps./dm.² The anolyte was coloured a dark red at the end of the run. The dye was precipitated from solution on the addition of 25 gm. of so-

dium chloride with good stirring. The precipitated dye was then filtered at the pump, sucked nearly dry, dried in the air oven at 80° C. and weighed. The quality of the dye was judged as usual by comparative dyeing tests and found to be quite satisfactory.

TABLE
Yield of Ponceau 2 R under Different Conditions of Electrolysis

Addition Agent	Weight gm.	Duration of Run (mins.)	Yield of Dye, gm.	Efficiency	
				Material	Current
None	..	20	..	..	..
NaNO ₃	1.65	60	2.30	38.0%	12.6%
NaOH	0.50	60	2.65	44.2%	14.7%
*NaOH + NaNO ₃	1.65 + 0.50	60	2.75	46.6%	15.3%
NaOH + NaNO ₃	1.65 + 0.50	120	5.73	95.5%	15.9%
*Iron Anode			2.75	46.6%	15.3%
Platinum Anode			2.30	38.0%	12.6%

The following interesting observations can be made from this table. The dye formation proceeds only in an alkaline electrolyte and better when sodium nitrate is added; the yield in this is seen to be maximum. The presence of nitrate does not cause corrosion of the anode. The yield of dye amounted to 95.5% of the theoretical if the electrolysis went on for 2 hours, or six times the theoretical duration. The current efficiency for a given set of conditions, appears to be independent of the concentration of the reactants, since the yield is quantitative if the electrolysis is prolonged for a sufficient length of time, which is almost an exact multiple of the theoretical time.

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Madras, V. V. RAMAN.
April 20, 1949.

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SURFACE TENSION OF SOLUTIONS OF CETYL PYRIDINIUM BROMIDE

ADAM AND SHUTE¹ have observed that the surface tension of dilute aqueous solutions of cetyl pyridinium bromide falls with time, attaining a final equilibrium surface tension, which is independent of the concentration. The rate of fall is very slow in dilute solutions and rises as the concentration increases until above a certain concentration the equilibrium is very quickly attained.

The idea presented here is very similar to Doss and Rao's² idea on the wetting of solids by liquids. It has been assumed that only a certain fraction of the surface is occupied by cetyl pyridinium bromide molecules in dilute solutions. As the concentration increases the fraction of the surface occupied by cetyl pyridinium bromide molecules also increases. When surface is allowed to age, molecules from the bulk of the solution come to the surface, taking time to work against the inward molecular forces. There is, however, a concentration at which the whole of the surface is covered by cetyl pyridinium bromide molecules and consequently the equilibrium is attained very quickly. Above this concentration probably micelle formation occurs and the surface tension remains unaltered.

The fraction of surface can be represented by,

$$\sigma = \frac{\gamma_{H_2O} - \gamma}{\gamma_{H_2O} - \gamma_E}$$

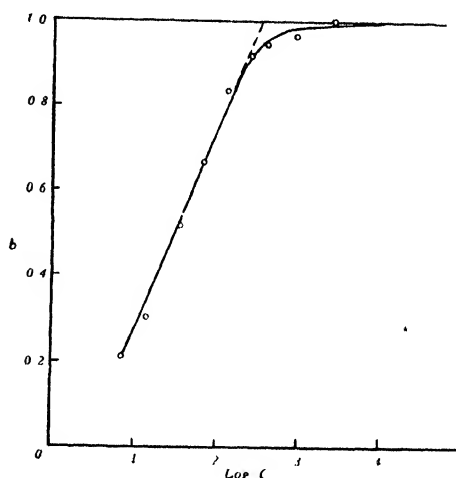
where γ_{H_2O} = surface tension of water,
 γ = Semi dynamic surface tension³ (i.e., surface tension of solution before ageing commences)
 γ_E = Equilibrium surface tension.

The measurement of surface tension was carried out by a Cenco-du Noué tensiometer at 25° applying correction as suggested by Harkins and Jordan.⁴ The values are given in the table below:

The equilibrium surface tension of 36 dynes/cm. was in agreement with Adam⁵ and Brown.⁶

In Fig. 1, the fraction of surface σ is plotted against the logarithm of concen-

quick. The concentration of 0.034% is in agreement with Adam's value of 0.04%



where slow fall of surface tension is abolished. The point at which the lower part of the curve deviates from the straight line gives us the concentration of 0.022% at which micelle formation begins. The concentration at which micelle formation begins is 0.028% from conductivity measurements. It, therefore, seems that micelle formation commences before the whole of the surface is covered by single cetyl pyridinium Bromide molecules.

My grateful thanks are due to Dr. M. R. A. Rao for kind advice.

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Values of semi-dynamic surfaces tension and fraction of surface occupied by cetyl Pyridinium bromide molecules at different concentrations

Conc. mg./litre	2786	929	398	253	132	68	34.4	13.96	6.96
Semi-dynamic surface tension dynes/cm.	36.0	37.5	38.0	39.2	42.0	48.0	53.5	61.1	66.5
σ	1.0	0.96	0.94	0.91	0.83	0.66	0.51	0.30	0.21

tration in milligrams per litre. By extrapolating the lower part of the curve to the line $\sigma = 1$, the concentration, at which the number of cetyl pyridinium bromide molecules is just sufficient to cover the whole of the surface is obtained. At this concentration ageing of surface becomes

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ADVERSE EFFECT OF MIXING TAPIOCA AND SWEET POTATOES IN WHEAT FLOUR

For overcoming the food shortage in the country, the Ministry of Food has recommended the mixing of tapioca and sweet potatoes meal in wheat flour. This scheme while calculated to increase of food supply of the country, is likely to produce an adverse effect on the health of the nation, which is already suffering from an ill-balanced diet.

For religious and economic reasons animal proteins (meat, fish and eggs) are ruled out from the diet of a good percentage of the people. The intake of dairy products is very low in our country, the *per capita* consumption of dairy products in India being about one-tenth of Canada and Newzealand, one-eighth of Great Britain and one-seventh of U.S.A.¹ Due to ill-balanced diet, the people are undernourished and are afflicted by many diseases. Shortage of good quality proteins and the B-vitamins are the two outstanding nutritional deficiencies in the cereal diet of the masses. Addition of some food rich both in good quality proteins and vitamins of the B-complex is necessary for balancing the cereal diet.

TABLE I

Chemical Analysis of Some Foods
Percentages

Foods	Protein	Fat	Carbo- hydrate	Moisture	Ash
Wheat (whole)	13.0	2.0	72.4	11.0	1.6
Sweet potatoes	1.8	0.7	27.9	68.5	1.1
Tapioca	0.6	0.2	86.4	12.6	0.2
Food Yeast (<i>Torula utilis</i>)	48.0	2.0	24.0	8.0	8.0

As evident from Table I both tapioca and sweet potatoes are rich in carbohydrates which is principally starch. The addition of these starchy foods to wheat flour would render it ill-balanced. The resulting mixture will have less protein and fat and much more carbohydrate. These changes in protein, fat and carbohydrate contents will be proportional to the quantity of tapioca or sweet potatoes incorporated. Thus though the caloric intake of food will be increased due to the added carbohydrate there will be a marked fall in the percentage of the protein, and is likely to be a more widespread incidence of the deficiency diseases in the country.

In order to make this scheme practicable, the proposed mixture will have to be fortified with good quality proteins and the vitamins

of the B-complex. As evident from Table I dried food yeast contains about 50% proteins of high nutritive value. Also yeast is a very rich source of B-vitamins. It can be added upto 5% to the flour, without any detectable change in taste and appearance of the product.

Food yeast can be easily produced in India either from molasses—a by-product of the sugar industry or from bassia flowers or from cellulosic waste materials such as wood, straw, stalks, husk, bagasse.

It is hoped that the Ministry of Food will reconsider their proposal and modify their scheme in the light of what has been presented in this note.

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June 5, 1949.

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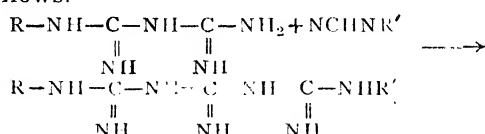
ATTEMPTS TOWARDS THE SYNTHESIS OF SUBSTITUTED POLYGUANIDES

ON the basis of their observations, Curd and Rose¹ put forward the hypothesis that for antimalarial activity, the aromatic ring and the basic side chain should be linked through a system of alternate carbon and nitrogen atoms with appropriate double bonds; they also argued that the "tautomeric possibilities existing within certain known active drug molecules" relate to the antimalarial activity. Paludrine, satisfying all the above conditions, has been claimed to be one of the best antimalarials obtained so far.

With this background, it was thought worthwhile to prepare compounds with a larger number of these conjugated system of carbon and nitrogen atoms, expecting that such compounds might prove to be better and more effective antimalarials. The polyguanides, such as tri-, or tetra-guanides or even the higher members are to provide more of the tautomeric possibilities and such other factors. This postulation was also supported by our observation that the monoguanide derivative with *p*-chlorophenyl- and isopropyl groupings present at the two ends, (*viz.*, N¹-*p*-chlorophenyl-N³-isopropyl-

guanidine acetate²), as in paludrine, was found to possess no antimalarial activity and was also found to be too toxic.³

Various methods were tried for the preparation of these compounds which are really biguanides lengthened further by the addition of one or more of guanidine residues. By analogy with the formation of biguanides from guanidines and cyanamides,⁴ the condensation of N¹-mono-alkyl (or aryl)-substituted-biguanide with mono-substituted alkyl-(or aryl)-cyanamides was tried for the preparation of triguanides as follows:—

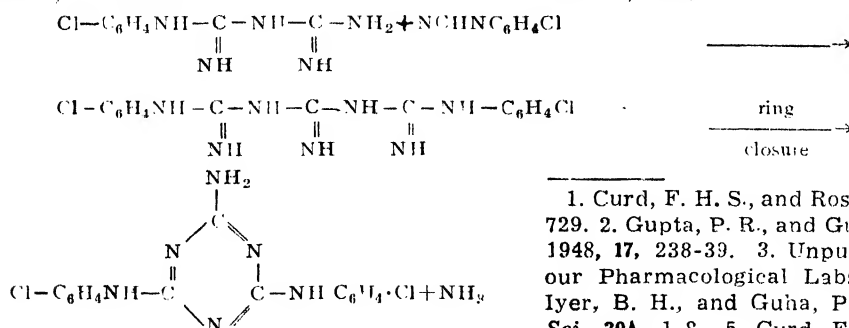


where R and R' = CH₃—, β-OHC₂H₄—, iso C₃H₇—, p-cl-C₆H₄—, etc.

The condensation was tried under varying conditions of experiments, viz.,

- In acidic, neutral or basic medium in alcoholic solution;
- In presence of pyridine or dioxane;
- Under ordinary pressure or under pressure in closed vessels.

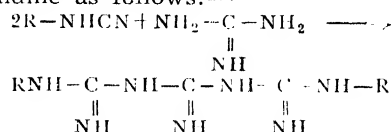
From the reaction products of none of these experiments, the desired triguanides could be isolated; in one particular instance, however, when the reaction was tried with p-chlorophenyl-biguanide and p-chlorophenyl-cyanamide in a closed vessel in alcoholic medium, ammonia came out profusely on opening the soda-water bottle, in which the reaction was conducted; and on working out the reaction product 2-amino-4:6-di-p-chloro-anilino-1:3:5-triazine-hydrochloride,⁵ (m.p. 284-85°; Nitrogen found: 22.36% C₁₅H₁₂N₆Cl₂, HCl requires 21.92) was isolated, which was evidently formed, from the triguanide, first formed, by ring closure, as follows:—



In some other cases unsubstituted melamine was obtained, which was crystallised from

water in fine needles, m.p. 213° C. (Nitrogen found: 66.82%; C₃H₆N₆ requires 66.6%.) The substituents were all knocked off during the process.

The synthesis was next tried by the condensation of two molecules of mono-substituted cyanamide with a molecule of guanidine as follows:—



where R = p-chloro-phenyl-.

From the reaction product no triguanide could be isolated but a compound having an m.p. of 253-55° C. and containing 16.85% nitrogen was isolated.

Lastly, with the same object, the condensation of N¹-p-Cl-phenyl-N³-cyanoguanidine with N¹-isopropyl-guanidine (either as a base or its salt) was also tried, but eventually some compound other than the triguanide could only be isolated. The substance was crystallised in shining flakes from 95% alcohol. It had an m.p. of 174° C. and contained 15.8% of nitrogen.

In most of the cases, very viscous semi-solid mass was formed which solidified only after a few days' standing. The exact nature and characterization of the compounds which were isolated during the investigation, as also other methods of synthesis are now being studied and will be published at a later date.

Authors' thanks are due to the Indian Research Fund Association for the award of a research fellowship to one of us (P. R. G.).

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June 4, 1949.

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ESTIMATION OF ACETIC ACID IN PYROLIGNEOUS LIQUORS

THIS paper outlines a fairly accurate and rapid method for the estimation of acetic acid in pyroligneous liquors.

Attempts have been made to remove the dark colour of the liquor and eliminate constituents which blacken on addition of alkali, by bleaching with animal charcoal,³ extraction,¹⁰ distillation^{5,6,7,7,8,1,12} distillation with extraction,¹ or neutralising the acid mixture with barium hydroxide and evaporation to dryness.⁸ All of these procedures are lengthy and require some sort of special apparatus. Acid is usually incompletely recovered in case of distillation methods. In the present method the liquor is purified by oxidation with permanganate in alkaline solution.

In most of the methods the purified liquor is titrated using phenolphthalein as indicator and the result reported as acetic acid. It is obvious that this procedure gives the total acidity and not the acetic acidity. In the proposed method the liquor after oxidation is acidified with sulphuric acid to liberate acetic acid and by potentiometric titration acetic acid can be estimated in a mixture of acetic and sulphuric acids. Potentiometric titration can be replaced by ordinary titration using tropeolin OO or methyl violet as indicators.^{4,9} Methyl violet has been tried by the present authors.

EXPERIMENTAL

Test samples were prepared by boiling 200 gm. of settled wood tar with 400 ml. of water for an hour and filtering when cold. To one ml. of the filtrate was added 2 ml. of acetate test solution² and excess NaOH and the whole brought to a boil. Absence of a green precipitate indicates absence of acetic and formic acid. Filtrate is now acidified with known amounts of acetic, formic, butyric and propionic acids and the volume made up to 1,000 ml.

5 ml. of the sample is pipetted in an Erlenmeyer flask and diluted to 200 ml. Excess alkali is added till the liquor is distinctly brown. About 15 gm. of permanganate crystals are added and the solution is heated over water-bath for two hours with constant shaking. Permanganate must still show in excess. After oxidation the liquor is allowed to cool and excess permanganate is taken up by hydrogen peroxide. The supernatant liquid will now be perfectly clear. If subsequently potentiometric titra-

tion is to be carried out the liquor is filtered and the filtrate received in 250 ml. beaker. If methyl violet titration method is to be followed, a 500 ml. Erlenmeyer flask will be more convenient. The precipitate is washed free of all acetate as is shown by the absence of a green precipitate on addition of the test solution.² After washing and reduction in volume to the desired extent all the filtrate is acidified with sulphuric acid till clear excess of the later is present. The solution can now be potentiometrically titrated to indicate sulphuric and acetic content separately. Alternatively a small quantity of methyl violet is added to the acidified liquor and titrated till the colour changes from blue to violet. This is noted as the end point for sulphuric acid. Titration is completed using phenolphthalein as indicator. Difference between the burette reading now and at the sulphuric neutralisation point gives a value for acetic acidity. Alkali used should be preferably N/10. Results of the experimental work are given in the following table:—

Sample No.	Non-oxidisable acids in ml. of NaOH required for titration			Titration reading for oxidised acidified liquor in ml. of NaOH		Acetic acid by difference between 5 and 6	Percentage error in estimation of acetic acid
	Acetic	Butyric	Propionic	Methyl violet titration	Phenolphthaleine titration		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	29.00	0.109	0.126	14.9	44.1	29.2	0.69
2	36.25	"	"	12.6	49.2	36.6	0.70
3	43.50	"	"	19.2	62.91	43.71	0.48
4	50.75	"	"	27.3	78.2	50.90	0.31
5	58.00	"	"	8.6	66.84	58.24	0.26

All of the above samples contained formic acid equivalent to 7.9 ml. of NaOH.

CONCLUSION

Whether purification is done by extraction or by distillation of the liquor it is necessary to free the distillate or the extract of its small quantities of soluble tar, formic acid, etc., by permanganic oxidation. In the proposed method therefore, the procedure has been cut short by conducting only the oxidation. Not only is the need for a special distillation or extraction apparatus avoided but a better clarification in a shorter time and with less attention can be obtained.

Loss of acid is also minimised. After oxidation, a further distillation is not necessary according to the present method. This is a decided advantage over Grotlisch's method.¹

The results of the table show that propionic and butyric acids get estimated as acetic. But this is so with other methods also. Although Grotlisch claims that butyric acid does not appear in the final distillate in his method the claim appears doubtful. As a matter of fact the proportions of these acids in the liquor are small enough not to affect the acetic acid estimation to any appreciable extent.

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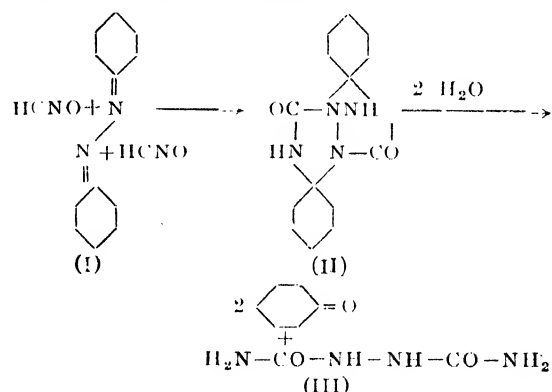
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CRISSCROSS ADDITION TO HYDRO-AROMATIC KETAZINES

WITH conjugated systems of double bonds addition generally takes place at 1, 4 or 1, 2 positions.^{1,2,3} However, conjugation between carbon and nitrogen, like $>C=N-N=C<$ as in azines, shows some peculiarities in addition reactions and Bailey, *et al.*, discovered a number of cases of 1,3-2,4 coupled-addition by the azine system.^{4,5} This type of reaction was named "Crisscross Addition" by Bailey and McPherson.⁵ A number of such additions with the azine system were subsequently observed.^{6,7}

All these observed cases of crisscross addition are, however, confined to aldazines and now the reaction has been extended to ketazines for the first time. Azines of hydroaromatic ketones add two molecules of cyanic acid in acetic acid below 10° C. with surprising ease, giving sharp melting, crystalline solids. The addition products

have been proved to be bitriazole compounds (II) by hydrolytic degradation to hydrazodicarbonamide (III); the course of reaction being as follows:



Crisscross addition of cyanic acid to cyclohexanone azine and 2-methyl and 4-methyl cyclohexanone azines gives the corresponding bitriazoles melting at 210°, 219° and 228.5° C. respectively.

The hydroaromatic ketazines also react with thiocyanic acid, maleic anhydride and α -naphthoquinone with the same ease, giving crystalline adducts. Work is in progress towards settling the structure of the addition products.

Organic Chem. Laboratories, D. B. DUTT.
Department of Pure & P. C. GUHA.
Applied Chemistry,
Indian Institute of Science,
Bangalore,
July 22, 1949.

1. Thiele, *Ann.*, 1899, 306, 87. 2. Michael, *J. pr. Chem.*, 1899, 60, 457. 3. Erlenmeyer, *Ann.*, 1901, 316, 43. 4. Bailey and Moore, *J. Amer. Chem. Soc.*, 1917, 39, 278. 5. Bailey and McPherson, *ibid.*, 1917, 39, 1322. 6. Wagner-Jauregg, *Ber.*, 1930, 63, 3213. 7. Van Alphen, *Rec. trav. Chim.*, 1942, 61, 892.

EMBRYO CULTURE TO OBTAIN F₁ PLANTS OF INCOMPATIBLE CROSSES IN CORN (MAIZE)

IN wide crosses, as a rule, in nearly all the ovules, after a definite period from the time of pollination, the endosperm begins to collapse. Shortly thereafter the embryo too collapses as its growth thereby gets arrested (Blakeslee and Satina, 1944). Occasionally in the hybrid one or more ovules may be found which are almost comparable with

those of the same age in a normal plant. These are usually only partially filled and ordinarily responds to embryo culture when young, while it is noticed that germination is very poor for these seeds when mature. The object of this experiment is to compare the germination by embryo culture of such immature partially filled seeds against that by the ordinary method of pot sowing, of such but mature seeds from incompatible crosses like a diploid \times tetraploid or a triploid \times tetraploid, in corn.



FIG. 1

A 2-Week old corn ear obtained by crossing a tetraploid female parent with a triploid male parent. Notice the different types of grains showing the fully filled, partially filled and the unfilled grains.

Out of the 13 diploid \times tetraploid crosses, that were made, 66 partially filled seeds were obtained. These seeds when pot sown, gave only 15 plants of which one turned out to be a triploid, the others showing varying numbers of chromosomes from 28 to 33. Chromosomes were counted from root tips

prepared by the usual paraffin section method, using crystal violet for staining.

Since as a rule, the embryos of the mature partially filled seeds of wild crosses do not germinate even under embryo culture, the embryo having already collapsed beyond the pro-embryo stage, an estimate of successful germination in a wide cross by embryo culture method, has to be attempted at an early stage of embryo development. With this end in view, the above triploid was crossed to a tetraploid.

In this cross between the triploid as the male parent and tetraploid as the female, it was observed that when the ovules were two weeks old, there were three distinct classes of kernels (Figure 1). They



FIG. 2

Photograph of the 3 types of grains indicated in Fig. 1 were (1) full round normal kernels, (2) partially filled small-sized kernels and (3) very small unfilled kernels (Figure 2). Evidently the last class represents the unfertilized ovules. The semi-filled and the intermediary sized kernels represent the real hybrid seeds. The counts made of kernels belonging to these three classes showed a ratio of 104 : 3 : 532. The ovules of the three hybrid kernels, when 16 days old, were dissected out and the embryos cultured in the Tukey's medium (Tukey, 1934) plus growth-promoting substances (Van-Overbeek and others, 1941). All the three

embryos grew into seedlings. The chromosome counts from the root tips revealed them to be heteroploids with chromosome numbers ranging above and below the triploid number.

It may be recalled here that out of the 66 partially filled tetraploid \times diploid crosses that were shown in pots only 15 germinated. Thus it will be seen that the percentages of germination by the ordinary method of sowing and by embryo culture at a very early stage of seed development, work out to be 23 and 100 respectively in this case. Embryo culture of very young seeds in this way helps to secure a greater percentage of F_1 plants out of incompatible crosses than by the ordinary method of germination of these seeds when ripe by pot sowing.

Agri. Res. Institute.
Coimbatore,
July 15, 1949.

P. UTTAMAN.

1. Blakeslee, A. F., and Satina, S., "New hybrids from incompatible crosses in *Datura* through culture of excised embryos on malt media," *Science*, 1944, **99**, 331-34. 2. Van-Overbeek, Marie E. Conklin and Blakeslee, A. F., "Factors in coconut milk essential for growth development of very young *Datura* embryos," *Science*, 1941, **94**, 350-51. 3. Tukey, H. B., "Artificial culture methods for isolated embryos of deciduous fruits," *Pro. Amer. Soc. Hort. Sci.*, 1934, **32**, 313-22.

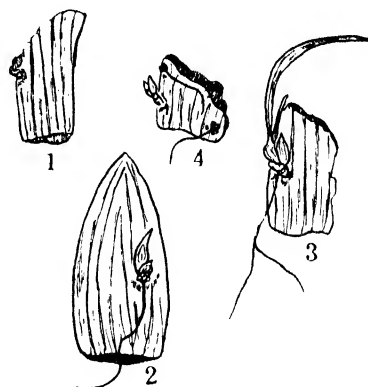
A NOTE ON THE VEGETATIVE PROPAGATION OF *LILIUM LONGI- FLORUM* WALL.

Lilium longiflorum Wall. belongs to the family Liliaceæ. It grows in Western Himalayas from Nepal to Kumaon at an altitude of 3-4000 ft. and is commonly cultivated in gardens as an ornamental plant.

The bulbs of this species were obtained from the Chandra Nursery, Sikkim, and grown in sand and garden soil respectively. After a few months when the bulbs were transplanted an interesting formation of vegetative buds on the scales was observed.

The usual method of vegetative propagation well known in bulbs is bud formation in the axils of the scale leaves. In this particular species besides such propagation, small buds were also formed on the scale leaves on their edges, the inner and the

outer surfaces (Figs. 1, 2 & 3). A single scale leaf sometimes produced as many as three such buds (Fig. 4). These made their appearance as small papillæ consisting of two overlapping opposite scale leaves. Later, however, they assumed the form of normal bulbs.



In an experiment a portion of the stem disc was cut and grown separately. It was observed that the innermost scale leaf formed a bud in the manner described above and when this scale leaf was removed the scale next to it behaved in a similar fashion. It is apparent that the scale leaves possess an inherent character for the production of vegetative buds. When, however, the scale leaves were separated from the stem disc and put on soil they failed to produce these buds.

Botany Department,
E-Punjab University,
Amritsar,
May 25, 1949.

P. KACHROO.

A NOTE ON THE MICRO-ORGANISMS PRESENT IN DATE-PALM JUICE (SENDHI)

In the year 1928 M. Damodaran has done work on "The fermentation of Toddy and an account of the micro-organisms producing it",¹ while later in 1939 V. S. Basrur and M. Qureshi² have done extensive work on the Date-Palm juice (*sendhi*) confining their attention to analysis only. The present note deals with the microscopic examination of fresh and fermented juice of *Phoenix Sylvestris* Roxb.

Samples of *sendhi* were obtained with the help of the Excise Department for our investigations. Possible precautions were taken

while collecting the *sendhi* to prevent extraneous micro-organisms getting into the liquid. The micro-organisms in the fresh juice were cultured on the *sendhi*-agar media. An examination of a number of isolated colonies under the microscope led us to suspect five kinds of organisms, which represent distinct species and these were later cultured by fractional plate cultures on *sendhi*-agar media. External morphology and nature of vegetation was carefully studied on streak cultures of *sendhi*-agar media and glucose-agar media. In the fermented *sendhi* samples however, in addition to the above suspected four micro-organisms mycoderma species was also found.

To identify the above micro-organisms, the cultural and the biochemical characters of each were studied and are described below. (For the identification of the micro-organisms, *The Yeast* by Guilliermond was consulted.³)

Description of the Organisms:—

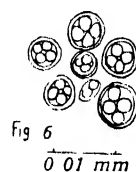
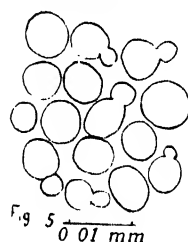
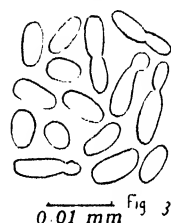
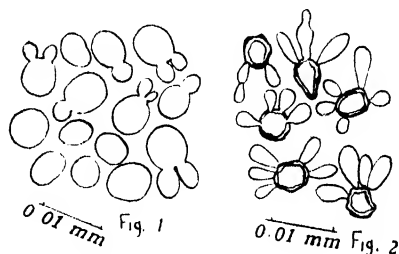
1. *Yeast A*. The colonies are club-shaped with depression in the middle and are smooth, glistening and white in colour. Streak cultures are smooth with broadly wavy margin. Multiple budding is often adopted as shown in Fig. 1. The cell form is predominantly spherical in young cultures. Durable cells are formed, and budding takes place giving rise to elongated cells as shown in Fig. 2. The thermal death point is 51-52° C. This organism is identified as "Yeast-like *Saccharomyces cerevisiae*".

2. *Yeast B*. The colonies are concentrically zoned and appear dry and powdery on the surface. Streak cultures develop flat, brown, spreading colonies. The cells are usually elongated as shown in Fig. 3. Scum is formed with growth ascending on glass wall. Four spores are formed in a cell as shown in Fig. 4. Thermal death point is 53-54° C. This organism is identified as *Pichia Radaisii*.

3. *Yeast C*. The colonies are white, pasty and with a surface formed of fine raised portions. Budding is of simple type. The cell form is predominantly spherical as shown in Fig. 5. Four spores are formed as shown in Fig. 6. Thermal death point is 52-53° C. This organism is identified as *Saccharomyces cerevisiae*.

4. *Yeast D*. The colonies are usually round, white and convex. Superficial vegetation is formed on the nutrient liquid. Cells are oblong, elongated and somewhat

elliptical. Budding occurs from end on shoulders as shown in Fig. 7. Thermal death point is 52-53° C. The organism is identified as *Mycoderma cerevisiae*.



5. *Bacteria*. The colonies are smooth, grey and glistening. Surface growth was observed after 48 hours, with a tendency to ascend at the edges. Deposit at the bottom is scanty, and slight turbidity is produced. The bacteria consists of short rods and are ellipsoidal in form. They occur singly and in pairs as shown in Fig. 8. This bacteria has many characters of *Acetobacter acetii* described by Jezdink Tosie and Thomas Kamedy Walker.⁴

To study the amount of growth and production of alcohol, the method described by F. G. Walter⁵ was followed. The results are shown in the table along with pH values.

No.	Description	Original pH	pH after incubation for 72 hrs.	Amount of growth per 100 gm. of glucose	Amount of alcohol by vol. per 100 c.c. of 3% glucose sol.
1	<i>Mycoderma cerevisiae</i>	6.0	3.0	17.1	nil
2	<i>Saccharomyces cerevisiae</i>	6.0	3.0	7.7	1.72
3	Yeast-like <i>Saccharomyces cerevisiae</i>	6.0	3.0	5.5	0.57
4	<i>Pichia Radaisii</i>	6.0	4.0	6.7	0.13

Our thanks are due to Dr. M. Qureshi under whose able guidance this work has been carried out, and also our thanks are due to Dr. S. Husain Zaheer, Director, Central Laboratories for Scientific and Industrial Research, for kindly permitting us to publish the note.

Hyderabad, Deccan, MOHAN BABU NAIDU.

June 12, 1949. J. LAKSHMIKANTHAM.

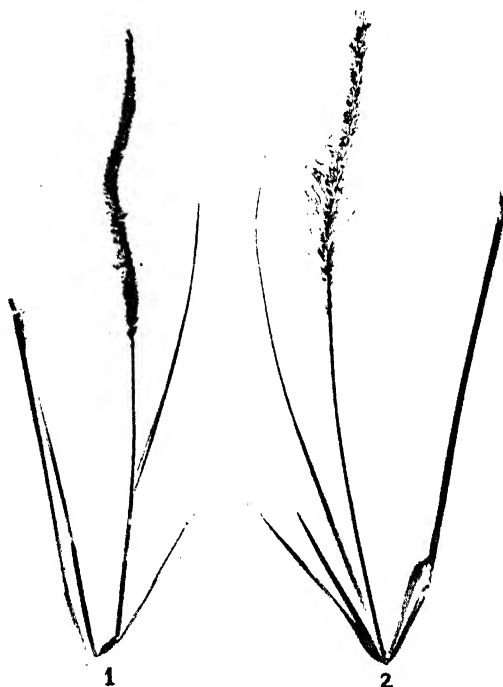
1. Damodaran, M., "The fermentation of Toddy and an account of the micro-organisms producing it," *Jour. Ind. Ins. Sci.*, 1928, 11, 63.
2. Basrur, V. S., and Qureshi, M., "Investigations on Palm Juice—Part I. Analysis of fresh and fermented juice," *Jour. Omania Univ.*, 1939, 7.
3. Alexandre Guilliermond, *The Yeast*, 1920 (John Wiley & Sons, New York).
4. Jezdink Tosie and Thomas Kamely Walker, "Acetobacter Acetii," *Jour. Soc. Chem. Ind.*, June 1946, 65.
5. Walter, F. G., *The Manufacture of Compressed Yeast* (1940, Chapman & Hall, Ltd., 11 Henrietta Street, W.C. 2, London).

PROLIFERATION OF SPIKELETS IN *PENNISETUM POLYSTACHYUM*, SCHULT.

ARBER (1934) observed proliferation of the spikelets of *Arrhenatherum avenaceum*, Beauv., *Festuca ovina*, L., *Phleum pratense*, L., *Poa alpina*, L., *P. vivipara*, L. and in some bamboos. Nielson (1941) has recorded such proliferation in *Avena sativa* L., *Bromus inermis*, Leyss., *B. purgans* L., *Festuca obtusa*, Spreng., *Phleum pratense*, L. and *Panicum virgatum*, L. Ganguly (1936), Reeves and Stansel (1940) have recorded maize spikelets proliferating into vegetative shoots and the latter authors have also found Teosinte (*Euchlaena mexicana*, Schrad.) showing similar phenomenon. Karper (1936) and Sankara Ayyar (1942)

have described the proliferation in *Sorghum* spikelets. A similar case was noted in Thin Napier (*Pennisetum polystachyum* Schult.) at the Rice Research Station at Tirurkuppam, Chingleput District, Madras, and this is being recorded here.

The normal inflorescence of *Pennisetum polystachyum* is a spike-like cylindric panicle (Figs. 1 and 2) brownish-yellow



FIGS. 1 & 2. Normal and proliferated inflorescence compared

and about a centimetre wide exclusive of the bristles of the involucre. The involucre, sub-sessile with about 30 bristles to each involucre. The spikelets usually solitary (rarely in twos), sessile; within the involucre, lower glume often suppressed, upper as long as the spikelet, thinly membranous, 5-nerved. Florets two, the lower empty or staminate, the upper, bisexual. Lower lemma, like the upper glume, 3-toothed at apex; palea subequal similar to the lemma or sometimes absent. Upper lemma chartaceous shining; palea similar, subequal.

The inflorescences with the proliferation of the spikelets could be easily made out

in the field by their bigger size and green colour. A detailed study of the inflorescence revealed that practically all the spikelets have been uniformly transformed into leafy structures.

The involucre surrounding each spikelet has not undergone any change (Figs. 3 & 4)

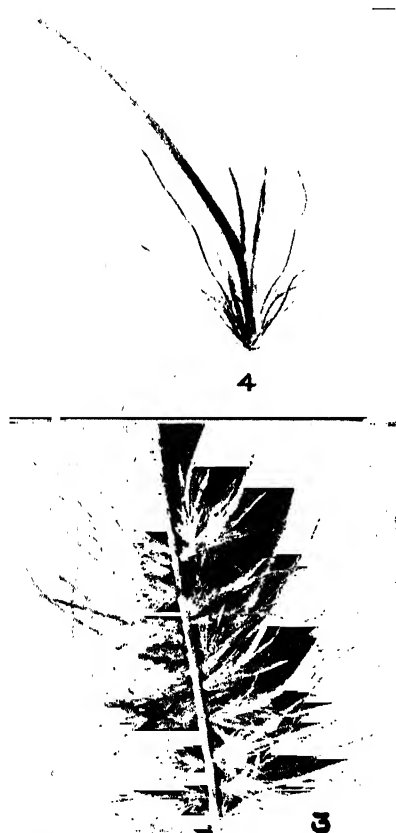


FIG. 3. A portion of the inflorescence with the spikelets proliferated

FIG. 4. A single proliferated spikelet. The involucre of bristles remains unchanged

while the spikelet alone has become proliferated. The proliferated spikelet gives a general appearance of a seedling (Fig. 4). The lower glume, which is often suppressed in the normal spikelet, is seen prominently, much elongated hyaline and thinly nerved. The upper glume is more than double the length of the lower, greenish, prominently nerved and hairy. The lemmas and paleas have developed into normal leaves with distinct blades, leaf-sheaths and the characteristic ligules of the fringe of hairs. This is of interest as the two lower glumes do not show this differentiation.

The present case of proliferation was noted in two clumps out of a small 5-cent plot cultivated with Thin Napier for fodder, from which a number of cuttings had already been taken. While it is difficult to explain the causes for this phenomenon of proliferation of spikelets, it may be pointed out that Karper (1936), Nielson (1941), Reeves and Stansel (1940) are of opinion that proliferations are due to environmental factors. Arber (1931) records two classes of proliferations, one brought about by environment and the other by chromosomal and hereditary causes.

C. RAJASEKHARA MUDALIAR.

D. DANIEL SUNDARAJ.

Madras Herbarium,
Agricultural College, Coimbatore,
June 15, 1949.

Arber, A., *The Gramineæ*, Univ. Press, Cambridge, 1934, 335-33. 2. Ganguly, B. D., *Curr. Sc.*, 1936, 5, 302-03. 3. Karper, R. E., *J. Hered.*, 1936, 27, 183-85. 4. Nielson, E. L., *Bot. Gaz.*, 1941, 103, 177-31. 5. Reeves, R. G. and Stansel, R. H., *Amer. J. Bot.*, 1940, 27, 27-30; 6. Sankara Ayyar, M. A., *Madras Agril. J.*, 1942, 30, 416-19.

RAIN OF PRAWNS IN SIAM

I HAPPENED to meet Mr. Spencer Leech, the representative of Winget Limited, Rochester, Kent, England, last week at Dakpathar, Dehradun District, where a Hydro-electric dam is under construction. In the course of conversation he mentioned to me a rain of prawns which occurred in Siam when he was a prisoner of war in the Japanese Camp at Damagan near Kanchanburi in the month of October 1944. I am aware of the literature relating to fish brought down by rains in India and outside but this is the first time I have heard of a shower of live prawns and the information seems to be perfectly authentic and was given to me by an eye witness. One evening towards the end of the monsoon in October (the exact date Mr. Leech does not remember) just before sun-down there was a heavy shower of rain. A large number of live prawns came down with the rain over the entire camp and could have been easily collected in basket-fuls. The size of the prawns was about 2 to 3 inches some of them had long chealate legs. He says that the camp was far away

from the sea but there was a lake within 8 miles of the camp where military planes are reported to have landed troops. The temperature at the time of rain was not particularly cold. I am told that there were persons interested in butterfly and orchid collections in the camp and therefore it is not unlikely that an account of this unusual occurrence has already been published. If so, I shall be obliged if any one who has heard or read of this occurrence will kindly let me know about it.

Dept. of Fisheries, U.P. B. SUNDARA RAJ.
Lucknow,
July 22, 1949.

ANTI-HISTAMINE ACTIVITY OF SUBSTITUTED BENZHYDRYL AMINES

RECENTLY, the discovery of benadryl has led many workers to study the anti-histamine activity of allied dialkyl amino-alkylbenzhydryl ethers.¹ In the present work, a number of substituted benzhydryl amine hydrochlorides have been tested for their anti-histamine property.

Method.—Anti-histamine activity was test-




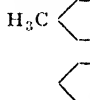
ed on the isolated ileal strip of a guinea-pig as follows: 0.1 mg. of histamine was added to the bath containing 60 c.c. of Tyrode's solution. It was allowed to act till the maximum height of contraction was reached. Then the histamine was washed out. Every time, the bath was emptied in order to wash out histamine or any drug, it was filled again with 60 c.c. of fresh Tyrode.

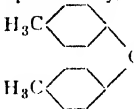
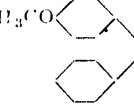
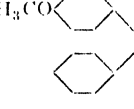
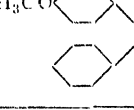
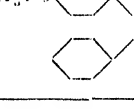
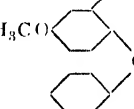
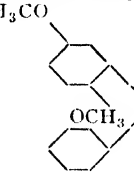
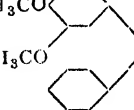
In this way, three consecutive equal responses were first obtained. These were used as the standard of the maximum response of the particular strip to the given dose of histamine. Next the compound under trial was added to the bath. At the end of ten minutes, 0.1 mg. of histamine was added to the same bath. When the maximum height of contraction was reached the compound and the histamine were washed out. Thereafter, every ten minutes, 0.1 mg. of histamine was added to the bath, till the height of contraction was equal to the original. This was taken as the duration of the anti-histamine activity of the compound.

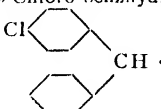
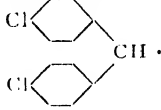

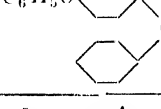
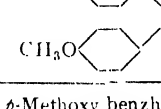
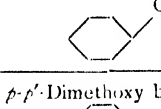
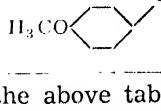
Benadryl has been taken as the standard for comparison.

Results of the work done so far are tabulated below:—

Anti-histamine Activity

No.	Compound Name and structural formula	Quantity added (mg.)	Duration of activity (minutes)
1	Benadryl <i>p</i> -Dimethyl amino ethyl benzhydryl ether hydrochloride  $\text{CHO} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{N} \begin{matrix} \text{CH}_3 \\ \text{CH}_3 \end{matrix}$	0.1	30
2	Benzhydryl amine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.5	20
3	N <i>n</i> -hexyl benzhydrylamine hydrochloride  $\text{CH} \cdot \text{NH} \cdot \text{C}_6\text{H}_{13} \cdot \text{HCl}$	0.1	less than 10
4	<i>p</i> -Methyl benzhydrylamine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.1	20

No.	Compound Name and structural formula	Quantity added (mg.)	Duration of activity (minutes)
5	<i>p</i> - <i>p'</i> -Dimethyl benzhydrylamine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.5	About 20
6	<i>p</i> -Methoxy benzhydrylamine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.1	less than 20
7	<i>N</i> -diethyl amino ethyl 4-methoxy benzhydryl ether hydrochloride  $\text{CHO} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{N} \cdot (\text{C}_2\text{H}_5)_2 \cdot \text{HCl}$	0.1	less than 20
8	<i>N</i> -isopropyl amino <i>p</i> -methoxy benzhydryl ether hydrochloride  $\text{CHO} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{NH} \cdot \text{CH} \cdot (\text{CH}_3)_2 \text{HCl}$	0.1	40
9	Succinyl <i>p</i> -methoxy benzhydrylamine  $\text{CH} \cdot \text{NH} \cdot \text{CO} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{COOH}$	0.5	less than 20
10	2:4-Dimethoxy benzhydrylamine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.1	About 20
11	3:6-Dimethoxy benzhydrylamine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	1.0	40
12	4:5-Dimethoxy benzhydrylamine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	1.0	20

13	<i>p</i> -Chloro benzhydramine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.5	About 20
14	<i>p</i> , <i>p'</i> -Dichloro benzhydramine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.5	20
15	<i>p</i> -Carboxy benzhydramine  $\text{CH} \cdot \text{NH}_2$	0.1	less than 10
16	<i>p</i> -Phenoxy benzhydramine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.1	60
17	<i>p</i> -Phenoxy <i>p'</i> -methoxy benzhydramine hydrochloride  $\text{CH} \cdot \text{NH}_2 \cdot \text{HCl}$	0.1	50
18	<i>p</i> -Methoxy benzhydryl β -methoxy ethyl amine hydrochloride  $\text{CH} \cdot \text{NH} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{OCH}_3 \cdot \text{HCl}$	0.1	less than 10
19	<i>p</i> , <i>p'</i> -Dimethoxy benzhydryl β -liethyl amine hydrochloride  $\text{CH} \cdot \text{NH} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{N}(\text{C}_2\text{H}_5) \cdot \text{HCl}$	0.5	20

From the above table it is clear that the following compounds are worth further investigation:—Nos. 8, 16 and 17.

Further work on the above compounds and a few more is in progress.

Our thanks are due to Dr. B. B. Dikshit, the Principal of the College who guided us throughout the work and to Prof. B. V. Bhice from S. P. College who supplied the compounds to us.

(MRS.) RANITA AIMAN.

Dept. of Pharmacology, M. B. GHARPURE.
B. J. Medical College, Poona,
July 11, 1949.

1. Fitzgibbon, *J.A.C.S.*, 1948, **70**, 387.

PROCESSES OF SEPARATION INVOLVING DIALYSIS

In a continuous dialysing unit involving a number of stages the operation is counter current, and the colloidal solution containing crystalloids, and water enter at the opposite ends of the system. Each stage will contain a semipermeable membrane between two cells into one of which flows the colloidal solution to be dialysed and into the other flows water for the removal of crystalloids. Such a process is analogous to multicontact processes like distillation, extraction, etc., and is sketched in Fig. 1.

Nomenclature.

G: mols of colloid flowing in the system per unit time, on a crystalloid-free basis.

L: mols of water flowing in the system per unit time, on a crystalloid-free basis.

Y: mols of crystalloid per mol of crystalloid-free colloid, in the colloidal system.

X: mols of crystalloid per mol of crystalloid-free water, in the water stream.

Subscripts:—1 refers to rich end streams and 2 refers to lean end streams.

Taking a crystalloid balance across a differential section of the unit shown in dotted lines, in Fig. 1.

$$G.dY \quad L.dX \quad (1)$$

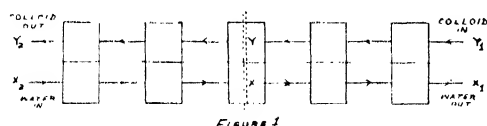


FIGURE 1

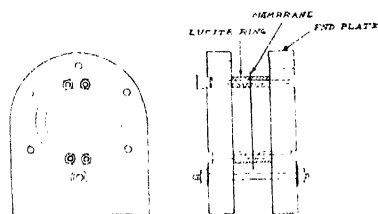


FIGURE 2

Integrating equation (1) between the variable compositions X and Y, and the terminal compositions X_1 and Y_1 , we have, on the assumption that G and L are steady,

$$G \int_{Y_1}^{Y_2} dY = L \int_{X_1}^{X_2} dX$$

$$\therefore Y - Y_1 = \frac{L}{G} (X - X_1) \quad (2)$$

Equation (2) defines the operating line that relates the composition of the colloidal stream that enters any stage and the composition of the water stream leaving the same stage. If the equation of the equilibrium line relating Y to X is known then it is possible to determine the number of theoretical stages required for the separation of crystalloid from a colloid by dialysis, by the stepwise method, provided the material balance of the system can be established. Further if the over-all membrane efficiency is known the actual number of stages required for the process can be calculated. To determine over-all membrane efficiencies experimentally it would be necessary to set up a unit containing a known number of stages and dialyse known solutions such that Y_1 , Y_2 , X_1 , X_2 , L and G are all known. If the equilibrium data are available then the theoretical number of stages may be calcu-

lated by the stepwise method. The over-all membrane efficiency is simply the ratio of the theoretical number of stages to the actual number of stages.

The author has made attempts to obtain equilibrium (Y—X) data on the system albumin-water-sodium chloride, using cellophane membrane (du Pont, No. 600) stretched between two lucite rings which were components of a laboratory dialyser made by Brosites Machine Co., of New York, (details of which are provided in the *Chemical Engineering Catalog*, 1947-48, page 372 Reinhold Publishing Corporation, New York) fitted up with lucite end plates as sketched in Fig. 2. By means of orifices provided in the end plates the spaces within the rings could be filled with known solutions. One was filled with a known solution of albumin prepared by saturating blood albumin (supplied by Fischer Scientific Co., Pittsburgh, Pa.) in distilled water, filtering, and adding a known weight of NaCl to a known volume of solution. The other was filled with water. The assembled unit was stored away in a constant temperature enclosure maintained at 70° F. The solutions were analysed at the end of 24 hours, and duplicates were run and analysed at the end of 48 hours and 72 hours until constant values were obtained. The NaCl solution was analysed by argentometry while the NaCl in the presence of albumin was calculated by difference, knowing the amount of NaCl present in the colloidal solution and the amount that was present in the water compartment. The following results were obtained:

Weight fraction of NaCl in colloidal solution	Weight fraction of NaCl in water
0.00199	0.00202
0.00572	0.0038
0.00954	0.00980

The work could not be continued owing to total destruction of the laboratory by a fire accident. The author wishes to thank Dr. James Coull, Professor and Head of Department of Chemical Engineering, University of Pittsburgh, Pittsburgh, Pa., for his interest in the work and the University of Pittsburgh for providing apparatus and facilities for work. Correspondence on the work is invited.

Poona 5,
July 6, 1949.

S. L. SASTRY.

GESTATION IN THE ORIENTAL VAMPIRES

BATS, which generally bring forth only one young at birth, have asymmetrical development of the uterine cornua. Species of bats in which details of pregnancy are available, show that gestation generally occurs in the right side of the female genitalia. The findings of Vogt¹ and Duval² in *Vespertilio murinus* (now called *Myotis myotis*); Courier³ in *Miniopterus schreibersi*; Baker and Bird⁴ in *Miniopterus australis*; Mathews⁵ in *Miniopterus dasythrix* and Sherman⁶ in *Tadarida cynocephala* support this view. My observations on *Rhinolophus rouxi* (Temn.) and *Tadarida tragata* (Dobs.) add two more instances to this category.

It appears as if this asymmetry has developed from a condition in which both the uterine cornua and the ovaries were functional. In *Pipistrellus pipistrellus*, Deansley and Warwick⁷ recorded 70 per cent. of the pregnancies in the right uterine cornu, 25 per cent. in the left and 5 per cent. in both. Guthrie and Jeffers,⁸ and Wimsatt⁹ described in *Myotis lucifugus* ova coming as frequently from the left ovary as from the right, but with pregnancies limited to the right side.

An instance of unilateral degeneration was found by Mathews¹⁰ in *Rhinolophus hipposideros minutus*. In this species the left uterine cornu is considerably smaller, and appears to be correlated with the functional atrophy of the left ovary which does not produce mature ova. Consequently the pregnancies are limited to the right side. It appears fortuitous which horn of the uterus becomes functional.

My observations on *Lyroderma lyra lyra* (Geof.) and *Megaderma spasma* (L.) the two Oriental Vampires of the family Megadermidae are interesting in this connection. Immature females in both the above forms have symmetrical uterine cornua. With the

attainment of sexual maturity the rapid enlargement of the left uterine cornu results in a distinct asymmetry. Sections show that only the left ovary is functional. A collection of these forms over a period of five years reveals that all the pregnancies are restricted to the left uterine cornu.

The findings of Mathews⁵ in *Cardiaderma cor* (family Megadermidae), revealed that pregnancies filled both uterine cornua but with the placenta attached to the left pole of the uterus suggesting that the development must have started in the left uterine cornu. He also recorded in *Nycteris luteola* (family Nycteridae) four pregnancies in the right uterine cornu and seven in the left showing a higher percentage in the latter.

In the families Megadermidae and Nycteridae there is a tendency for the left side of the female genitalia to be the functional one. The cause for this asymmetry is not clear.

My thanks are due to Dr. L. S. Ramaswami, D.Sc., Professor of Zoology, Central College, Bangalore, for encouragement and for a discussion of this problem.

Dept. of Zoology, P. A. RAMAKRISHNA,
First Grade College,
Tumkur,
August 15, 1949.

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Dr. J. N. MUKHERJEE

DR. J. N. MUKHERJEE, D.Sc., F.N.I., Director, Indian Agricultural Research Institute, New Delhi, has proceeded to U. S. A. as a member of the Indian Delegation to attend the United Nations Conference on the Conservation and Utilization of Resources to be held at Lake Success, from 17th August to 6th September 1949. He has been invited by the Secretary-General, U.N.O., to preside over the Land

Section Meeting of the United Nations Scientific Conference.

After attending the Conference at Lake Success on his way back he will attend the meeting of the General Assembly of the International Council of Scientific Unions to be held at Copenhagen, from 14th to 16th September 1949.

REVIEWS

Advances in Enzymology, Vol. VIII. Edited by F. F. Nord. (Interscience Publishers Inc., New) York, 1948. Pp. ix+538, Price \$ 8.00.

The eighth volume of this internationally well-known Annual contains critical reviews on ten different topics contributed by authors whose own contributions to their respective fields have been both large and substantial. This happy circumstance imparts to the discussions a "living touch" which is both illuminating and inspiring. The review on the functioning of the cytoplasm by Ludwik Monne deals with the advances made on the structure and the function of the cytoplasm during the last decade. The author has made a valuable contribution towards a clarification of well-established facts and valuable hypotheses. The second article pertains primarily to a discussion of the "two parallel and independent series of investigations, which together have contributed largely to a more modern and objective, although still woefully incomplete, understanding of the actual nature of complement". In the third article, J. P. Greenstein has presented a critical review of a group of comparatively little known but physiologically significant enzymes, the dehydropeptidases. I. L. Chaikoff and C. Enteman in their review on "anti-liver factor of the pancreas" have advanced convincing evidence of an yet unidentified anti-fatty liver factor associated with the pancreas. Alkaloid Biogenesis is the subject of a fascinating discussion by Ray F. Dawson in the light of the recent gene-enzyme-linked syntheses demonstrated by Beadle and Tatum in *Neurospora*. The discussion on the functional rôle of alkaloids in the physiological economy of the plant is suggestive.

Cellulose which is the most abundant organic compound occurring in Nature, has been the subject of numerous investigations directed towards its chemurgical exploitation. Nord and Vitucci have presented a critical review pertaining to a microbiological approach to this problem. Lignin which is invariably and intimately associated with most of the naturally occurring celluloses has also been considered and the authors have presented experimental evidence to show that an enzymatically formed methylated aromatic compound might serve as an intermediary between carbohydrate degradation and lignification.

Other reviews include Synthesis of Lipids by Kleinzeller, the Biochemistry of Fatty Acid Catabolism by F. L. Breusch, Lipoxidase and the Auto-oxidation of unsaturated Fatty acids by Sune Bergström and Ralph T. Holman and a fascinating contribution by E. Albert Zeller on the Enzymes of Snake Venoms and their Biological Significance.

Editor Nord who is the founder and guiding spirit of this series of volumes, has been successful in securing for this series an international status; the present volume contains 5 articles from the U.S.A., 2 from Sweden, 1 each from Czechoslovakia, Turkey and Switzerland. This is a volume which will commend itself to a wide circle of investigators interested in a critical appraisal of the progress of biological chemistry in its most comprehensive sense.

Chromatography. By Harold G. Cassidy and others. *Annals of the New York Academy of Sciences*, Vol. XLIX. Pp. 141-326, 1948. Price \$ 2.75.

Chromatography, first discovered by Tswett in 1906, has proved itself in recent years to constitute a powerful and extensively applicable analytical tool. With its aid, compounds considered as single entities have shown themselves to be mixtures and have been resolved into their individual constituents. The method has been employed for checking the homogeneity of a compound and for establishing its identity or non-identity with another sample by a mixed chromatogram test (cf. mixed melting point test).

Harold G. Cassidy, the consulting editor, prefacing the bunch of contributions says that "it was felt profitable to examine the state of our knowledge regarding chromatography, and especially to make it possible for workers using one method of adsorption analysis to come together with those using other methods, so that all methods might become more widely known. It was hoped that, through such a meeting, the chromatographic tool might become further sharpened and the realm of its proper use redefined". At the conference, 14 papers have been presented including the introductory and concluding remarks by the consulting editor. The history, scope and methods of chromatography have been presented by Zechmeister, in whose hands

the method attained a substantial stage of development. Henry C. Thomas has presented "a review of pertinent parts of the equilibrium theory" and has given a mathematical treatment of single solute chromatography for the two simplest reasonable mechanisms of adsorption considered as a kinetic process. Stig Claesson has described the experimental set-up for chromatographic adsorption analysis developed by Tiselius and his co-workers. The ingenious and elegant "partition chromatography" developed by Martin and Synge, using filter paper, has been described by Martin while the starch column chromatography which makes use of the same partition principle is described by Moore and Stein. Paper strips handle only microgram quantities of the material whereas columns handle milligrams.

A review of fractionation of mixtures by foam formation is presented by Shedlovsky, a promising technique which involves the participation of mobile surfaces and one which has hardly been investigated. Applezweig has presented a very useful paper on "Ion-exchange Adsorbents as laboratory tools" and an equally useful contribution has been made by Deitz on "the surface areas of some solid adsorbents of possible use in chromatography". Other contributions include Systematic Quantitative Chromatography by Schroeder, Fractionation and Analysis of Hydrocarbons by Adsorption by Mair, Stereochemistry and Chromatography by Zechmeister and Chromatography in the Streptomycin Problem by Peck.

The volume represents a very stimulating contribution to the subject of chromatography, which is being, at the moment, extensively employed as fruitful method of analysis.

High Molecular Weight Organic Compounds: Frontiers in Chemistry, Vol 7. Edited by R. E. Burk and O. Grummitt. (Interscience Publishers Inc. N.Y.), 1949. Pp. vi + 330, Price 5.50 dollars.

This is a new addition to the now well-known series sponsored by the Western Reserve University. A vast amount of work in recent years has been with synthetic high polymers, with an emphasis that has practically flooded out the work that is still needed and being done on the natural polymers: proteins, cellulose, starches and the pentosans. This tendency is reflected also in the volume under review. Cellulose finds only the briefest reference and only proteins find a place. The other two types are non-existent so far as the current volume goes.

The first two reviews by Dr. Mark give a

lucid account of the work carried out in the Brooklyn Polytechnic on polymerisation in suspension and emulsion as well as the use of osmometric and viscometric methods in polymer investigations. The experimental details presented, as well as the analytic treatment of the different aspects of the problem will be found particularly useful by newcomers to the field. The term Ac_2 in page 80 is obviously a misprint unless Bc_2 in the next line is an error for Bc_2 . The contribution of Dr. Fisher is a highly condensed one on Elastomers and if it is intended for a student certainly requires elaboration. The only contribution in the volume on a natural polymer is that of Dr. Edsall on proteins. We have here a critical account of the different lines of investigation suggestive of further work in the subject in every section in a field which remains "a quest that will call for ingenuity, skill, and imagination of the highest order". Condensation polymers and phenoplasts are dealt with respectively by Drs. Flory and Carswell. These are quite in line with the rest of the volume in providing a useful critical review.

Even though the field of high molecular weight organic compounds is not fully covered, the volume will be a useful addition to a library for advanced students and the price is quite moderate for the contents.

S. V. ANANTAKRISHNAN.

Recent Advances in Analytical Chemistry: Frontiers in Chemistry, Vol. 7. Edited By Burk and Grummitt. (Interscience Publishers Inc., N. Y.), 1949. Pp. viii + 200. Price 4.50 \$.

The volume is the latest addition to the series under the same editorship and the title will be welcomed by those interested in chemical analysis. Seven reviews are presented in the volume and, looking at the title one is surprised to find that Chromatography in which we see a good deal of work done during the last few years finds no place.

The opening review by Kolthoff gives a bird's eye-view of polarography. Two chapters on the use of organic reagents in inorganic analysis follow. The nature of the topics make cataloguing an essential part of the review but one regrets the absence of critical treatment. The greater part of the first article on the subject deals with material which cannot by any means be termed recent. Nor does one see from the contributions what one might consider an abnormal emphasis on colour reactions using organic reagents that tend to use dispersion agents even where precipitates

are formed, in order to use a colorimetric method of estimation, though this happens to be the case. The use of dithizone in estimations of lead or of anthranilic acid in estimations of zinc find no reference. The contribution is none the less useful in giving indications of procedure for trying out a new reagent in analytical work. Infra-red spectroscopy is becoming increasingly important as an analytical tool and the contribution by Beeck is full of useful information. The longest monograph in the volume is the one on electron microscopy. The actual application to analyses does not find any detailed treatment but this is probably in the nature of the subject. To one not conversant with the intricacies of work in this field, the contribution is an excellent appetiser. Rossini treats the study of hydrocarbons with old tools in "the new dress of greater accuracy, greater precision and greater efficiency" but the reader can get little information useful to him on the details of these changes in experimental technique from the rather poor photographs on pp. 158 and 172. We have, however, some compensation in having useful information, found only in journals not readily available in this country. World War II has brought into the forefront as an analytical tool an instrument that was available in few laboratories before that date, viz., the mass spectrograph.

This has played an important part in recent work in the analysis of complex mixtures of gases, and vapours and the concluding article appropriately deals with this topic.

The volume under review is on the whole mixed fare that will nevertheless find a place in the library of any one interested in analytical work.

S. V. ANANTAKISHNAN.

Surface Active Agents. By Anthony M. Schwartz and James W. Perry. Interscience Publishers Inc., New York and Interscience Publishers Ltd., London, 1949. Pp. xi + 579. Price \$ 10.00.

This book deals with the achievements of the last three decades in the newly developed field of surface-active agents. The processes for synthesising and manufacturing surface-active agents are systematically described. The physicochemical surface and bulk properties as the gross effects associated with the solutions of surface-active agents have been dealt with. The applications to the different industries such as textiles, cosmetics, pharmaceutical, metal working, paints and lacquers,

leather, paper, etc., are discussed in detail. The treatment is in general comprehensive though a reference to the theory of contact angles, mechanism of wetting action, effects of surface-active agents on acid-base indicators and the work on the spreading of surface-active agents on aqueous surfaces would have rendered it even more complete. An up-to-date alphabetical list of commercial surface-active agents, their nature and uses could have been included with advantage.

The presentation of subject-matter and the get-up are very good. There are hardly any errors of any kind and by way of an exception one may point out that on p. 279 line 32, wherein the words "more" and "less" are to be interchanged in order to get the correct sense. This book contains much useful information and is valuable to the technologists and scientists who wish to get posted with the information in the field of surface-active agents.

K. S. GURURAJA DOSS

Fieldbook of Natural History. By E. Laurence Palmer. Whittlesey House (McGraw Hill Book Co. New York.) 1949. Pp. x + 664 with 2,000 text-illustrations. \$7.00.

This is the fourth publication in the well-known Whittlesey House Field Guide series, addressed to American readers and students of field sciences. The present work by Prof. Palmer aims at providing a ready work of reference on objects of natural history that one encounters in every day life. As stated by the author in his preface it is not a textbook in any science nor a manual for the identification of objects considered in any of the sciences. It is a field guide which persons who take some interest in their natural surroundings could consult and obtain information in a form that is non-technical, condensed and aided by illustrations. Such a work can never be exhaustive as the material has to be restricted in scope; in general, the author has attempted "to choose those things found most commonly in an unmodified or still identifiable form in the field, stream or wood lot, in the grocery or fruit store, or behind the kitchen sink".

The material is arranged in sections dealing with astronomy, the mineral kingdom, and the plant and animal kingdoms. The first two subjects occupy only a small portion of the book but these sections are valuable owing to a series of charts on the astronomical side and numerous monochromes with notes for identification in the pages devoted to minerals.

The plant life is dealt with in about 300 pages, closely following and indicating the taxonomic sequence and with accounts of chosen examples under each natural order. The majority of examples dealt with are from the North American flora but reference may be found to many plants of economic importance not found in America. The animal kingdom is dealt with in the next three hundred pages. The same procedure is followed in both the sections; each topic is illustrated at the top of the page, with the description given below in clear graphic style giving means of identification, distribution, features of structure and natural history, and economic importance. There is also an index which facilitates reference. The value of the work to non-American readers lies in the notes relating to species of economic importance, both plant and animal, distributed all over the world and information on which is not readily available in a single book, but the reader should be prepared to find several omissions of items of special interest to him. One may, however, always turn over the pages of this beautifully printed and profusely illustrated volume with pleasure and profit.

N. K. P.

Rinderpest Vaccines—Their Production and Use in the Field. (Food and Agricultural Organization of the United Nations, Washington, U. S. A., March 1949). Pp. 71. Price One Dollar.

Rinderpest is a widespread disease of cattle in Africa, Asia and Far East, and is responsible for the death of at least 2 million head of cattle with a constant threat of the spread of the disease to regions of the world where it is not prevalent at present. It causes considerable reduction in the world supply of milk and meat, and what is more serious, in the destruction of animals owned by farmers and used primarily for the Agriculture of the land. In spite of the magnitude of this economic loss there was no concerted and uniform measure for the eradication or even mitigation of this scourge. The prophylactic vaccines which are in use are not of uniform standard regarding potency and immunising quality. The method of production of vaccine and its use in the field varied in different countries and there is no absolute proof that the vaccine which was used in the field was of the desired potency in all cases and gave sufficient protection to the herds. In the vaccination against small-pox ever since Jenner's discovery de-

velopment was so rapid that a more or less uniform standard of vaccine lymph was introduced in every country and vaccination programme was enforced by legislation so that considerable reduction was effected in the incidence and severity of small-pox. Similar efforts are necessary in the eradication of this terrible disease of Rinderpest.

In the stress of the post-war food scarcity the F. A. O. of the U. N. has interested itself in the problem to adopt adequate measures of control at international level. The present report is based on the meeting of the F. A. O. in co-operation with the British colonial office at Nairobi. At the meeting held between 28th October to 1st November 1948, 22 countries and territories participated in discussing method of controlling Rinderpest and unanimously adopted certain conclusions in the eradication, vaccines, etc. They considered the merits and defects of various types of vaccination.

- (1) Serum virus simultaneous immunization.
- (2) Inactivated virus-tissue vaccination.
- (3) Goat virus vaccine.
- (4) Lapinized virus-vaccine.
- (5) Avianized virus-vaccine.

This last one was used with great success in China causing less reaction than any other attenuated virus vaccine and no deaths.

Many advantages were claimed in favour of this vaccine although more research was needed on the aspect of occasional difficulty experienced in adapting the virus to egg embryos. This vaccine can be attenuated to any desired point of effectiveness and safety to be used on hypersusceptible animals. Further work is needed to assure uniform keeping quality of the vaccine. The cost of this vaccine is very low. These points are sufficient for extended trial of this vaccine. It is expected that an intense world wide programme of control measures will result in the ultimate mitigation if not eradication of this deadly disease of cattle.

K. P. MENON.

The Physical Chemistry of Process Metallurgy.

The publication No. 4 in the series of discussions of the Faraday Society is a collection of papers read at the discussions held under the auspices of the Faraday Society from 23rd Sept. to 25th Sept. 1948. Distinguished physical chemists and metallurgists took part in the discussion.

The discussions cover three aspects of Process Metallurgy, viz, (1) Metallic solutions, (2) Roasting and Reduction processes, (3) Slags and Refining processes.

The introductory address by Sir Andrew McCance is followed by a paper on "The Physico-Chemical Principles in Process Metallurgy" by Sir Charles F. Goodeve. The author deals with the general principles of physical chemistry and the two important approaches in physical chemistry: the kinetic and the thermodynamic. The kinetic approach which starts with a picture of the intimate molecular mechanism of a chemical change, followed by mathematical deduction to allow comparison with experimental results, has been applied with success to gaseous reactions and perhaps is capable of general application. The thermodynamic approach has the desirable quantitative exactitude. He refers to the possible application in study of slag refining processes deoxidation of steel, etc.

The brilliant introduction is followed by several papers relating to the study of metallic solutions. Some outstanding contributions have been made. The paper on "Activities in liquid metallic solutions" by John Chipman dealing with the concept of activity, the thermodynamic equations involving it and the methods of determining activities, *viz.*, vapour pressure, E.M.F. measurements phase diagrams, chemical equilibrium, is a useful contribution. He introduces the concept of semi-regular solutions and describes its usefulness in metals.

The second paper by J. A. Kitchener and collaborators deals with "The activity of sulphur in liquid iron: the influence of carbon." A thermodynamic treatment of experimental results on the interaction of sulphur with iron is given. The influence of carbon in desulphurisation is studied and the authors conclude that sulphur activity is doubled approximately by saturation of the melt with carbon at 1560 C.

John Lumsden in the paper on "Thermodynamics of lead-zinc alloys" deals with lead-zinc phase diagram activities of Zn in the system. He concludes that the percentage of Pb. in zinc produced at each stage of the distillation is independent of the amount of Pb. present in the charge, provided there is sufficient lead to saturate the gas through the cycle of operations. The temperature and hence the lead content of zinc condensed increases as the distillation proceeds.

R. M. Barrer examines some equilibrium and kinetic aspects of interstitial solid solutions, conditions for formation of such phases in his paper on "Aspects of Gas Metal Equilibrium, interstitial solution and diffusion." An attempt has been made to interpret the hard-

ness and inertness of some of these phases in terms of the theory of metallic bond due to Pauling.

In the next paper on "Kinetics of nitrogen evolution from an iron interstitial alloy" by Charles Goodeve and K. H. Jack, the rates of denitriding of Σ -iron nitride in vacuum, N_2 , CO, and H_2 have been determined with X-ray studies.

Details and important features of construction of molybdenum furnaces are given in the paper on "Notes on the experimental technique of some physico-chemical measurements between 1000-2000 C." by J. A. Kitchener and collaborators.

In the last paper in the series on "Elimination of thermal diffusion error in studies of gas metal equilibrium" by Mina Dastur and John Chipman, the errors are said to be eliminated by the use of pre-heating or inert gas.

The series is followed by a general discussion.

The second section contains eleven papers. The important paper is on "The general survey of roasting and reduction processes" by C. W. Dannatt and H. J. T. Ellingham. Charts giving standard free energy of formation ($-\Delta G$) of oxides and sulphides: variation with temperature will be useful according to the authors in the study of mechanisms and rate of reaction in extraction processes.

An examination of some properties of the diagrams of complex equilibria constructed by plotting of inverse of the absolute temperature as abscissa and log. of equilibrium oxygen pressures as ordinate has been made by Pourbaix and collaborator in "Graphical study of metallurgical equilibrium".

The use of voltaic cells of the Daniell type with molten salts has been discussed in the paper on "Studies in the thermodynamics of metallurgical reduction processes by electrochemical methods" by B. A. Rose and collaborators.

The next paper on "The primary reactions in roasting and reduction processes" by Anderson summarises some evidence derived from studies of semi-conduction in oxide and sulphide systems.

Peretti discusses the use of X-ray methods of study and cylindrical briquettes in the paper titled "A new method for studying the mechanism of roasting reactions". The same author deals with the defects of bottom blow converter in "An analysis of the converting of copper matte."

S. E. Woods examines the possibility of "The reduction of oxides of iron as a diffusion-controlled reaction" in his paper.

Pure metal crystallites cannot start dissociation of CO but it requires the presence of an interface like Ni-NiO or Fe-Fe₃C or the prior formation of carbon nuclei. This is explained with precise measurements by A. Juliard and collaborators in "Kinetic study of the dissociation of CO accompanying the reduction of metallic oxides".

L. M. Pidgeon discusses the reduction of dolomite by ferro-silicon at 1100–1200 C in his paper on "The vapour pressure of Mg in the thermal reduction of MgO by ferro silicon". The vapour pressure of Mg has been found to be much higher than was usually accepted. CaF₂ catalyses but has no effect on the equilibrium vapour pressure.

The last two papers are by Gross and collaborators, the first titled "Some equilibria involving Al monohalides" the second "The reduction of ZnS by Fe".

The series is followed by a general discussion.

In the third series there are seven papers. The interesting paper by Richardson on "The constitution of thermodynamic of liquid slags," covers the present state of knowledge of the structure and thermodynamic theory of solutions and the methods of determination of the activities from liquid immiscibility and from melting point diagrams. Solidification curves of binary silicate systems are plotted. These curves together with data on the stability of silicates and some potentiometric determinations give an idea of the change of activities.

The ionic mechanism of conduction process in the systems is substantiated in the paper on "Electrical conductivity of silicate melts: the systems containing Ca, Mn, and Al," by J. O. M. Bockris and collaborators.

The concept of molecular species is examined in relation to the properties of non-stoichiometric phases and in relation to the use of law of mass action in steel making equilibria, by G. M. Willis in his paper on "The constitution of phases at high temperature in relation to their thermodynamic properties".

In the paper on "Equilibrium relationships in systems containing iron oxide and their bearing on the problem of the constitution of liquid open hearth slags" P. Murray and J. White consider the above two aspects of the constitution of slags.

That the carbon content of the bath is the factor which has the greatest influence upon the oxygen content during the refining period and Mn has no influence, are the conclusions mentioned by Fornander in his paper "The behavior of oxygen in liquid steels during the refining period in the basic open hearth furnace".

The last paper on "The physical chemistry of sulphur removal in steel making" by Carter deals with role of different oxides present in free state in desulphurisation. The author concludes that their ability is the same. If in a combined state the ability is diminished. Mn in the metal can have no effect on the final equilibrium distribution except in so far as it may increase the activity of sulphur in the metal phase.

A general discussion follows this series.

The publication is a valuable addition to any Metallurgical library.

J. B.

Organic Reagents used in Gravimetric and Volumetric Analysis. By John F. Flagg. (Interscience Publishers Inc. New York), 1948. Pp. xiv + 299.

The book under review is a welcome addition to the existing books on chemical analysis and fills a definite gap in the literature on inorganic quantitative analysis, though some aspects of the subject have been covered by other books also.

The book has been divided into two sections, the first part deals with the theoretical aspects of the subject and gives a short resume of the organic chemistry involved in the use of organic reagents. The physical and chemical properties of the compounds with which the analyst deals have been discussed. The section concludes with a chapter on special techniques that are required in analysis with organic reagents. The second section is devoted to a detailed discussion of the various important organic precipitants and gives a sufficiently complete picture of the behaviour, use and further scope of the reagents.

The book describes mainly the macro-methods of analysis, and a reasonably complete bibliography of the micro-methods has also been included.

A glance at the various organic reagents will reveal that most of them are of the type that form chelate complexes. A book like the present one will invoke considerable interest in the minds of organic chemists to test other similar compounds or to synthesise substances

which may ultimately prove to be more useful in analysis.

The appendix embodying the (i) table XXX presenting the drying temperatures and conversion factors of the precipitates formed of the inorganic elements with the organic reagents, and (ii) table XXXI indicating the various organic reagents used for each element, makes the book very handy and convenient for immediate reference.

The general get-up of the book is good and the present volume will undoubtedly find a place in all the modern libraries.

P. C. GUHA.

Human Ancestry from a Genetical Point of View. By Professor R. Ruggles Gates. (Cambridge, Mass. Harvard University Press; London: Oxford University Press, 1948). Pp. xvi + 422, 27 Plates. 42s. net.

Fossil evidence for the ancestry of Man was scanty in the days of Darwin, but the publication of his *Descent of Man* in 1871 was followed everywhere by vigorous search for the so-called missing links. The number of discoveries throwing light on human ancestry has been indeed large during the last seven decades, but in several cases the material was either too fragmentary or the stratigraphic information too flimsy. Interpretational difficulties due to personal equation have also been great. If, for example, in a discussion of the status of the Piltdown woman's brain, Keith could regard it as "comparable to modern man" and Elliot Smith, on the other hand could put it down as "the most primitive and most simian brain", common sense tells us that several of our seemingly learned writings on human evolution are in the pre-logical mode. Very large segments of the world including those which, on theoretical grounds, should be regarded as areas of characterisation of early Hominids, have not been properly searched for bone relics. Taxonomic studies on living Man have also not produced satisfactory results to clear the existing confusion. We do not yet know enough of human genetics, human biochemistry, etc., to be in a position for any one authoritatively to analyse and say what primary races or species of man constitute the highly mixed geographical groups of any part of the world. It is under these circumstances that Prof. Ruggles Gates has ventured on the present review of the problems from his own special angle.

The main thesis of the book is that the concept of Linnaeus that all living types of man belong to one species should be "repudiated"

and instead of regarding them as sub-species, the main races such as the Caucasian, Mongolian, Australian, Negroid and Bushmen should be elevated to the rank of species. These species sprang from three different stems, in three different parts of the world, but since all the three sprang from a common primitive miocene stock they have been undergoing parallel evolution. In other words, the very large number of points of similarity between the different "species" of man is due to parallel evolution over a long period and the points of difference due to new mutations. In "splitting" the species *Homo sapiens*, Gates seems to be simplifying problems too much; he overlooks the many difficulties which confront the practical worker in the field. As matters stand at present, the diagnosis of human subspecies is indeed difficult and confused, but if these sub-species, on the suggestion of Gates, are to be elevated as species, it should be possible to give clearer criteria for them than for mere varieties. No helpful suggestions are given on this important question. The subjective feelings of Gates on this culturally vital, but scientifically not so important, question of human races are countered by the views of others, equally competent, among whom is included Darwin.

The valuable part of the book is the discussion of the palæontological data concerning man. No important discovery till 1946 has been left out. At p. 56 is given a scheme of primate evolution which summarises the author's views. *H. caucasicus*, *H. africanus*, Hottentot, and Bushman evolved from *H. capensis* (Boskop), which in its turn came from *Africanthropus* (Neanderthal); *Sinanthropus* gave rise to *H. mongoloideus* including variety *americanus*; and *Pithecanthropus* gave rise to *H. australicus*. This scheme is quite different from those given by Clark and Weidenreich and in places less convincing, but as Hooten says in his Foreword, "So I would not urge upon the reader of this useful book, *Human Ancestry*, that he accept its contents as eternal verities".

There are a few misprints, Riedschoten (p. 154), Aijappan (p. 356). At p. 153, Eickstedt is quoted with approval ignoring the criticism of Dr. Guha. At p. 133 there is a statement to the effect that the Nordics are the only people who combine dolicocephaly with hypsicephaly, but the reviewer's work on the Nayadis summarised at p. 357 shows that these two characters are combined in that tribe.

A. AIYAPPAN

SOME METHODS OF PURIFICATION AND INDUSTRIALLY IMPORTANT REACTIONS OF *p*-CYMENE

JAMES VERGHESE

THIS review deals with some methods of purification and industrially important reactions of *p*-Cymene (i) not discussed in the previous paper.⁵⁸

PURIFICATION

The chemical industry needs pure (i) for its syntheses and processes. Out of the crude (i) obtained from liquid and vapour phase dehydrogenation of terpenes, from sulfite turpentine and essential oils, it is extremely difficult to isolate (i) by fractional distillation. Other hydrocarbons also distil over along with (i) necessitating expensive additional steps.^{1,2}

Careful distillation followed by treatment with sulfuric acid is stated to be the best for refining (i).⁴ Essentially the unsaturated impurities are thus destroyed but the ejection of the isopropyl chain from (i) resulting in a high yield (65%) of toluene is also reported.⁵⁹ Various concentrations and quantity of acid are recommended.^{2,3,5,6,8,14}

Wheeler⁷ observed that concentrated acid slightly sulphonated (i). Methods based on complete sulphonation are also used.^{9,10,11,12}

Digestion with metallic sodium,^{5,13,14,15,16,17,19} phosphoric anhydride,¹³ oxidation with Beckmann's reagent¹⁷ or potassium permanganate,^{5,14,17,18,21} fractional distillation under reduced pressure^{13,14,19}, bromination,¹⁴ and dehydrogenation over a catalyst,²⁰ are some of the aids to purification.

Patents are granted for refining by treatment with condensing agents, e.g., zinc chloride,^{21,22,23} and gaseous hydrochloric acid.²⁴

Extraction of (i) with fuming sulfuric acid containing 15% sulfur trioxide^{25,26} and liquid sulfur dioxide,²⁷ chromatographic separation^{28,29} of *p*- and *o*-Cymenes followed by fractional crystallisation of their sulfonamides,^{28,30,31} are the latest improvements to the methods of purification.

Pure *p*-Cymene should display no unsaturation.³

REACTIONS

Action of aluminium chloride

Anschutz³² heated (i) with one-third its weight of aluminium chloride, and obtained a liquid reaction product containing toluene. Treatment with 16% by weight of aluminium chloride, according to Moore and Egloff,³³ yielded 0.8% benzene, 14.3% toluene, 7% xylenes, 28.5% unchanged (i), and 48.4% unidentified jelly-like mass. In presence of hydro-

chloric acid, McKee³⁴ obtained toluene, propane and a small quantity of tar.

The combined action of aluminium chloride and benzene on (i)^{35,36,37} with the formation of isopropyl benzene and toluene afforded a true reversal of Friedel-Crafts reaction, and suggested a striking possibility of utilising (i). Isopropyl benzene is a remarkable fuel (aviation-) blending agent.³⁹ It is a raw material for the production of benzoic acid.³⁷ Methods have been developed to dehydrogenate it to α -methyl styrene³⁸ which can be isolated in a state of purity.⁴¹ 80% decomposition of this hydrocarbon almost exclusively into propylene and benzene is effected at 500° over a $\text{SiO}_2\text{--ZrO}_2\text{--Al}_2\text{O}_3$ catalyst.⁴⁰

Schorger^{17,42} carried out several series of experiments from 65–100° with varying amounts of aluminium chloride and showed that there are formed diisopropyl, benzene, toluene (40%), *m*-xylene and *l*-methyl-3,5-diisopropyl benzene. At room temperature, according to Lacourt,⁴³ no gas was evolved during 10 days; benzene, toluene, xylene, 1,3,5-diisopropyl toluene, unchanged (i), and a high boiling residue were isolated.

Friedel-Crafts Reaction

Equimolecular amounts of aluminium chloride (i) and acetyl chloride gave *p*-acetyl toluene, unchanged (i), an intermediate ketonic fraction (b.p. 126–132.5°/16 mm., n_D^{18} 1.5228), acetyl-*p*-Cymene, a fraction of b.p. 138–145°/16 mm., n_D^{18} = 1.512, and a brown viscous residue. The best yield of acetyl-*p*-Cymene (97%) is obtained by dropping an equimolecular mixture of (i) and acetyl chloride into aluminium chloride in carbon disulfide at 10°. Oxidation with nitric acid (d. 1.15) indicated that the keto group is ortho to methyl.¹³

Acetyl-*p*-Cymene is likely to find numerous industrial uses. Typical constants are: d_4^{20} 0.9864; d_{20}^{20} 0.9654; n_D^{20} 1.51849, boiling range 124.2–125.2°/12 mm.

Tertiary-butyl-*p*-Cymene

Extensive decomposition of (i) resulted on interaction with aluminium chloride and tert-butyl chloride, whilst with tert-butyl alcohol and con. sulfuric acid at -10–0°, tertiary-butyl-*p*-Cymene (1:2:4 $\text{C}_6\text{H}_5\text{Pr}^t\text{CMe}_3$) was formed in good yields. This on nitration (fuming HNO_3 , <0°) gave 3:5 dinitro derivative possessing intense musk odour.⁴⁴

Pressure Cracking

The density of (i) hardly changed on cracking in an Fe-autoclave for 3 hours at 425°. Volatile products were less than 10%. The gases contained 1.1% unsaturated hydrocarbons, 2.3% carbon monoxide, 68.5% hydrogen and 28.1% methyl hydrocarbons. About 1% toluene and 3% xylene were obtained.⁴⁵

Action of Nitrosyl-Sulfuric Acid

Puranen and Ehrnrooth¹¹ describe specific processes for the production of a hydrocarbon C₂₀H₂₄, by treating (i) at a low temperature with a solution of nitrosyl-sulfuric acid in con. sulfuric acid. The nitrosyl-sulfuric acid may be formed *in situ*. The heavy hydrocarbon formed is amenable to nitration, chlorination or sulfonation, and is useful for the manufacture of explosives and dyes.

Hydrogenation

In the gas phase (i) is hydrogenated to *p*-menthane (75%) over nickel at 180°⁴⁷. Kobe and Vittone⁴⁸ accomplished the liquid phase hydrogenation at 220° under pressure in the presence of 1% nickel.

p-Menthane is an excellent solvent, saturated, and with extremely narrow boiling range.⁴ The latest developments in the *p*-menthane industry are its oxidation to acidic compounds,^{1,10} and to a solvent, wetting and disinfectant composition consisting largely of tertiary alcohols and ketones,⁵⁰ dehydrogenation to 4- α -dimethyl styrene,⁵¹ and the utilisation of its *cu*-mercaptide as a stabiliser for lubricating oils used in internal combustion engines.⁵²

Sulfonation

The 2- and 3-Cymene sulfonic acids are important intermediates in the manufacture of carvacrol, thymol and various dyes, and are useful for hydrolysis of fats.⁵³

Sulfonation of (i) with sulfuric acid at various temperatures and also with 15% oleum had been carefully studied.^{54,55,56} Temperature is the principal factor in determining the relative quantities of the two isomers produced.⁵⁴ 15.6% of 3-sulfonic acid is obtained by the action of sulfuric acid at 100° with 1:3 ratio of (i) to acid.⁵⁴ Temperatures above 100° and sulfates, e.g., CuSO₄, HgSO₄ are unfavourable.⁵⁴ At 0° with oleum, the yield of this isomer dropped to 2.5% and a 90% Ba-2-sulfonate was recovered.⁵⁴

Fevre⁵⁵ sulfonated (i) with sulfuric acid containing 15% SO₃ and obtained the following yields of Ba-2-sulfonate: (a) 0-10°, 87-91%; (b) 50-80°, 49.5-53% and (c) 90-100°, 49%.

Substitution in (i) (1 mol.) with sulfuric

acid (2 mols. d. 1.84) at 50-75° and 100° for 4 hours gave 78-90% 2-isomer and 20% 3-isomer.⁵⁶

Isolation of the 2-sulfonic acid as the magnesium salt has been patented.⁵⁷

I desire warmly to thank Prof. Dr. R. B. Sandin, of Alberta University, Edmonton, Canada, for his invaluable suggestions and encouragement in preparing this review.

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SCIENCE NOTES AND NEWS

Engineering and Marine Exhibition in London

The organisers of the Engineering and Marine Exhibition (incorporating the Welding Exhibition), which takes place at Olympia, London, from August 25 to September 10, have already issued their official bulletin of the exhibits, from which some indication of the scope of this event may be obtained.

With the patronage and active support of the British Engineers' Association, the Society of Motor Manufacturers and Traders (Marine Section), the British Electrical and Allied Manufacturers' Association, the Institute of Welding and the British Acetylene Association, the Exhibition promises to display a representative selection of the products of these important branches of the United Kingdom industry.

Several well-known makes of oil engines for marine propulsion and auxiliary services as well as for industrial and traction purposes, will be available for inspection. One stand will be devoted to the uses and possibilities of aluminium in shipbuilding and marine engineering, whilst another firm, specialising in the manufacture of solid drawn seamless non-ferrous tubes, will exhibit copper and brass tubes and fittings for a variety of uses. Other products will include transmission belting of all types, electric motor control equipment, pneumatic tools, lubricating oils and greases, electric duplicating machines as well as modern

drawing office and photo print-room equipment and materials.

Complete ranges of welding equipment, accessories and electrodes will be shown in the Welding Exhibition.

A world-famous Clydeside engineering company will be showing scale models of its products. These include a luxury liner, ships' machinery, and gas turbines for use ashore. The Department of Scientific and Industrial Research and the Board of Trade will show how the Government can assist industry.

Biochemistry at Cambridge

"NATURE" has announced that Professor A. C. Chibnall is to shortly retire from the Sir William Dunn Chair of Biochemistry. He will be succeeded in October next by Professor F. G. Young who is holding the Chair of Biochemistry at the University College of Science in London.

International Mining Congress at Oxford

The technical progress and problems of the mining industry of the British Commonwealth were discussed at the Fourth Empire Mining and Metallurgical Congress held at Oxford recently. In the course of the discussions, Sir John Cockroft, Director of Britain's Atomic Energy Establishment, pointed out that the development of atomic energy hinges upon an adequate supply of uranium and thorium, without which all the efforts of the atomic scientists would be useless.

The search for uranium has brought into general use among prospectors the Geiger-Muller counter. One speaker told how in Canada its use had led to the discovery of uranium deposits in Ontario, Saskatchewan, the North-West territories and British Columbia. Also, measurements of the force of gravity, of electrical conductivity and magnetic forces have been pressed into service in modern aerial surveys. Aerial photography has proved invaluable for quickly covering large areas not easily prospected on the ground; detecting devices slung beneath aircraft have been useful, especially in dealing with snow-covered territory.

Several speakers dealt with working conditions in mines and refineries. A mass of information has been collected on the effects on the human body of high temperatures, humidity, poor ventilation and other factors which affect both health and output. In consequence, it has been possible to define a limit as to what may be tolerated, and often to suggest how working conditions may be improved. Such surveys have extended even to the psychological effects of working under extreme conditions.

The Congress has made it clear that the British Commonwealth has immense mineral resources, many of which are already being worked, while thorough surveys are being made to locate the rest in regions never fully prospected. Special attention is also being given to the problem of working ores poorer than those normally accepted, which is the problem facing miners everywhere, and one in which a powerful lead is of great importance.

London Conference of E.N.T. Specialists

More than 1,300 delegates, including about 900 specialists in ear, nose and throat diseases from 39 countries, are now in London attending the Fourth International Conference of Otolaryngology. India is represented by four delegates. Dr. C. A. Amesur of Bombay, Dr. (Miss) C. M. Leelavathi of Madras, Lt.-Col. P. Papatla of Cuttack and Dr. D. Rom of Patna.

The Congress programme is packed with readings of scientific papers, with technical discussions and with visits to hospitals and clinics.

The patron of the Congress is the King, and it was opened on his behalf by the Duchess of Kent. The President is the celebrated surgeon, Mr. V. E. Negus.

By the time the Congress ends the delegates will have heard the results of clinical and research work in otolaryngology throughout the world.

New Director of the National Physical Laboratory, England

The Lord President of the Council has appointed Professor E. C. Bullard, M.A., Ph.D., F.R.S., Professor of Physics in the University of Toronto, to be Director of the National Physical Laboratory. It is expected that Professor Bullard will take up the appointment in January, 1950.

Professor Bullard will succeed Sir Charles Darwin, K.B.E., M.C., Sc.D., F.R.S.

Foodstuffs for Animal Establishments

The Government of India have agreed to the proposal by the Council of Scientific and Industrial Research for the issue of rations for rats and other animals maintained by various laboratories for biological and biochemical experiments, and accordingly arrangements are being made by the Provincial and State Governments for the issue of rations at the rate of half an ounce of cereals per rat per day, to *bonafide* research workers on applications duly forwarded by the Heads of Departments concerned.

Andhra University Award of Research Degrees in Physics

On the recommendation of the Board of Examiners consisting of:—

1. Prof. Max Born (*Chairman*), University of Edinburgh, Edinburgh (Scotland), 2. Prof. P. P. Ewald, Queen's University, Belfast, Northern Ireland, 3. Prof. J. J. Weigle, Institute of Physics, University of Geneva, Geneva, appointed to adjudicate on the thesis entitled "Studies in Some Aspects of Crystal Physics," the Syndicate of the Andhra University has resolved that Mr. D. Suryanarayana, M.Sc., be declared qualified for the degree of Doctor of Science (D.Sc.).

On the recommendation of the Board of Examiners consisting of:—

Prof. J. J. Weigle (*Chairman*), Institute of Physics, University of Geneva, Geneva, Switzerland, 2. Prof. P. P. Ewald, Department of Mathematical Physics, The Queen's University, Belfast, Northern Ireland, 3. Prof. Jean Cabannes, M.Sc., Dean of the Faculty of Sciences, Sorbonne, Rue Victor Cousin, Paris 5, appointed to adjudicate on the thesis entitled "Diffraction of Light by Ultrasonic Waves," the Syndicate has resolved that Mr. B. Ramachandra Rao, M.Sc., be declared qualified for the degree of Doctor of Science (D.Sc.).

INTERNATIONAL SCIENTIFIC AND TECHNICAL CONGRESSES

Date 1949	Subject of Conference	Organising Body	Location
Aug. 17- Sept. 6	United Nations Scientific Conference on Conservation and Utilisation of Resources	U. N. Information Centre, Russel Square House, W.C. 1	Lake Success, U.S.A.
Sept. 1-3	2nd International Congress on Electro-Encephalography	M. Baudoin, Faculte de Medicine, University de Paris	Paris
Sept. 3-10	26th Session of International Statistical Institute	H. Campion, Esq., Central Statistical Office, Great George Street, S. W. 1.	Berne
Sept. 5-10	4th International Neurology Conference	Dr. Raymond Garcin, 19 Rue de Bourgogne, Paris 7.	Paris
Sept. 5-7	International Association for Hydraulics Structures Research		Gronoble
Sept. 5-9	Colloquium on Nuclear Physics	International Union of Pure and Applied Physics	Bale
Sept. 5-11	15th General Conference, International Union of Chemistry	Organising Committee, P. O. Box 71, Leyden, Netherlands	Amsterdam
Sept. 6-10	Conference on Low Temperature Physics	Prof. G. C. Slater, Department of Physics, Massachusetts Institute of Technology	Cambridge, Mass. U. S. A.
Sept. 9-12	Summer Meeting of British Society of Soil Science	Dr. E. W. Russell, Department of Agriculture, Oxford University	Leeds
Sept. 11-16	Colloquium on Cosmic Rays	International Union of Pure and Applied Physics	Como
Sept. 12-17	The Laurentian Hormone Conference	Chairman, 222, Maple Avenue, Shrewsbury, Mass.	Franconia, U. S. A.
Sept. 12-17	International Congress of Mechanical Engineering	Secretary of Congress, Centre de documentation de la Mecanique, 11 Avenue Hoche, Paris 8	Paris
Sept. 12-17	International Colloquium on the Absorption of Heterogeneous Kinetics	Centre National de la Recherche Scientifique, 13 Quai Anatole France, Paris 7	University of Lyon
Sept. 14-16	General Assembly, International Council of Scientific Unions	Prof. F. J. M. Stratton, Conville and Caius College, Cambridge	Copenhagen
Sept. 18-23	American Chemical Society, 116th National Meeting	American Chemical Society	Atlantic City
Sept. 19-30	4th Session of U.N.E.S.C.O. General Conference	U.N.E.S.C.O.	Paris
Sept. 19-23	Symposium on Engineering Structures	Prof. A. G. Pugsley, Merchant Venturers Technical College, Bristol 1	Colston Research Society, Bristol
Sept. 29- Oct. 1 & 4	Summer Meeting of Groupement pour l'Avancement des Methodes d'Analyse spectrographique des Produits Metallurgiques	G. A. M. S., 1 Place, St. Thomas d'Aquin, Paris 7e	Paris
Sept. (Undecided)	F.A.O. Conference on Locust Control	Food and Agriculture Organization	Central America
Oct. 1-9	International Congress of Scientists concerned with Colonial Development	Ingenieurs pour la France D'Outre-Mer et les pays Exterieurs, 11 Rue Tronchet, Paris 8e	Paris
Oct. 3-10	Autumn Meeting of Institute of Metals	Secretary, Institute of Metals, 4, Grosvenor Gardens, S. W. 1.	Paris
Oct. 17- Nov. 1	African Regional Scientific Conference	C. S. I. R., P.O. Box 395, Pretoria	Johannesburg
Oct. 23-30	22nd International Congress of Industrial Chemistry	Societe de Chimie Industrielle, 28, Rue St. Dominique, Paris 7	Barcelona
Oct. (Undecided)	F.A.O. Meeting on Control of Infestation in Stored Grain	Food and Agriculture Organization	Palmira, Colombia
Nov. 1-5	Pacific Chemical Exposition	James O. Clenyon, Research Association of California Research Corporation	San Francisco

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	PAGE		PAGE
<i>Scientific Aspects of Silk Production</i> ..	321	<i>Some Examples of Quartz-Grain Orientation in Tectonites and Non-Tectonites</i>	
<i>The Atomic Clock</i>	322	—SAURINDRANATH SEN ..	328
<i>The Effect of Carbon Monoxide on the Respiration of Artificially Bivoltinized Silkworm Eggs</i> —ALEXANDER WOLSKY	323	<i>Oxidation of Lac by Lead Tetraacetate</i> —HARIPRASAD A. BHATT AND N. R. KAMATH ..	331
<i>Sugarcane (Saccharum officinarum) Top Silage as Feed for Cattle</i> —N. D. KEHAR AND B. SAHAI	325	<i>Letters to the Editor</i> ..	333
<i>Third Symposium on Applied Mathematics</i> —Elasticity	327	<i>Reviews</i> ..	351
		<i>Aquametry</i> ..	358
		<i>Pest Infestation Research</i> ..	360
		<i>Bee Compass</i> ..	361
		<i>Science Notes and News</i> ..	362

SCIENTIFIC ASPECTS OF SILK PRODUCTION

LIKE many other Indian Industries, silk production, in the past, has had to pass through many vicissitudes and misfortunes; these periodic crises have been analysed neither with sufficient scientific precision nor with a full appreciation of the complex factors which influence the biological production of silk. The approach to the problem hitherto has been largely on the economic and organisational fronts and all the serious and conscientious attempts in this direction have not apparently helped this important industry to stabilise itself.

The finding that the silk fibre offers the best and the safest material for the manufacture of parachute fabrics, was responsible for rocketing the prosperity of the industry during the war. As was expected, with the return of peace, and with the phenomenally rapid rehabilitation and rise of the Japanese industry, the Indian silk

is, at the moment, threatened once again with a crisis.

Our contributions to the scientific studies of the silkworm and of its fibre, have not been comparable either in quality or in quantity to those made by others in this field. Our researches in this direction would be appraised as comparatively inconsequential, mediocre and third rate. The reasons are not far to seek. In spite of the great and abiding interest which our National Government have recently been evincing, the general conditions for scientific work in the Country still remain uncertain and discouraging; they cannot attract first-rate men to take up scientific research as a career. Plans and proposals for starting a Central Institute for Silk Research, we are told, were made three years ago; nothing concrete, however, has so far emerged. The Government has been slow in taking decisions in this matter.

To-day, the investigator who aspires to

elucidate the fascinating problems of silk production—biological and biochemical—is in an exceptionally advantageous and a far happier position. If he is properly equipped, he can command a variety of experimental techniques and methods which have been developed in recent years. In this connection we must refer to the spectacular work of Zamecnik and his colleagues (*Science*, 1949, 109, 624) who, working in the Chemical and Biological Laboratories of the Harvard University, have accomplished the biological synthesis of radioactive silk. They have tested the ability of the giant silkworm *Platysamia cecropia*, to incorporate radioactive glycine and alanine into the silk it synthesises. The radio activity was shown to be present in the α -carboxyl group of some amino acid associated with the silk fibre.

Silk is a protein, biologically elaborated by the silkworm and broadly comparable to the casein elaborated by the mammary glands of the cow, to the albumin of the egg laid by the hen and to the wool grown by the sheep.

Thanks to the brilliant and sustained researches of the European, the American and the Australian investigators, the effi-

ency of the three biological agencies—the cow, the hen, and the sheep—as converters of their respective feed proteins into their characteristic protein secretions—the casein of the milk, the albumin of the egg, and keratin of the wool fibre—have been worked out. The cow has been found to possess a conversion efficiency of about 80 per cent.; the hen comes next with an efficiency of only 50 per cent. In the case of the sheep, Australian workers have found that a daily dose of a gram of cystine increases the yield of wool by 30 per cent.

The biological efficiency of the silkworm as a converter of feed protein into silk protein is a problem which awaits solution. There are several other problems of similar magnitude and importance facing us in the field of silk production.

The All-India Silk Board, which, we understand, has been constituted, will, we hope, take up this question and lay down a progressive policy of vigorous and sustained research which must be recognised as the only infallible and rational means of placing the silk industry on a sound and stable foundation.

THE ATOMIC CLOCK

FOR many years, at the United States Naval Observatory and other national observatories where time is recorded and dispensed, quartz-crystal-controlled clocks have been used to keep time as accurately as does the earth itself—to about 1/1,000 of a second per day. Nevertheless, quartz-crystal clocks are subject to vagaries that have indicated the need for even more accurate means of control. This has now been found in what is known as the "atomic clock," developed at the National Bureau of Standards by Dr. Harold Lyons and members of the staff of the Bureau's microwave research laboratory.

The frequency of an absorption line produced in the microwave region of the spectrum by ammonia gas under a pressure of 10 or 15 microns is now used as the "governor" on apparatus capable of time constancy of one part in 10 million, with a theo-

retical potential accuracy of one part in a billion or more. If the microwave signal output of a quartz-controlled frequency generator differs in frequency from that of the ammonia absorption line, the control circuits generate an error signal which brings the microwave signal back to the frequency of the spectrum line.

In addition to its obvious astronomical applications, such as furnishing an invariant check of the earth's rotation, the atomic clock will prove invaluable in many fields. It will provide room for more stations in the radio broadcast spectrum, as station transmitter frequencies can be maintained to very close tolerances. It will aid all radar operations and navigation systems that depend on radio, and will assist in basic research in microwave spectroscopy and molecular structure. (By courtesy to *Sky and Telescope*, 1949, VIII, P. 223.)

THE EFFECT OF CARBON MONOXIDE ON THE RESPIRATION OF ARTIFICIALLY BIVOLTINIZED SILKWORM EGGS*

ALEXANDER WOLSKY†

(From the Hungarian Biological Research Institute, Tihany)

IN earlier publications of this series (Wolsky, ^{1, 2, 3}) the theory has been advanced (based on concepts of Rumström and other concerning sea-urchin eggs, e.g., ^{4, 5}) that the increase in the intensity of respiration that occurs in silkworm eggs at fertilization is due to a change in the submicroscopic structure of the cytoplasm of these eggs (see also Wolsky⁶). This is supposed to remove some barriers between respiratory enzymes and their substrates and to make the enzymes (the amount of which does not change) more "saturated", i.e., heavier engaged in their catalytic activity than before fertilization. This would explain the fact that before fertilization the respiration cannot be blocked with mixtures of oxygen and carbon monoxide (one of the specific poisons of the iron containing respiratory enzyme known as Warburg's "Atmungs-ferment" or cytochrome-oxidase) whereas it becomes susceptible to this poison at fertilization when the rate of respiration is almost doubled. The explanation which the theory offers is the following (see also Fig. 1):

(1) Before fertilization the cytochrome oxidase is in surplus and only a fraction of it is actively engaged in the catalysis of respiration. Therefore the carbon monoxide (which competes with oxygen for the enzyme so that they "partition" it among themselves according to Warburg's formula) combines with surplus only leaving enough of the enzyme free to combine with oxygen and to keep up the respiration at the level which is normal in this stage.

(2) After fertilization a far greater portion of the cytochrome-oxidase is "on duty", i.e., becomes engaged in the catalysis of respiration and the reserve is greatly reduced. Therefore a similar treatment with oxygen-carbon monoxide mixtures will affect not only the reserve of the enzyme but also that part which is needed for the upkeep of the respiration. Consequently the rate of respiration will be reduced.

It is clear that this explanation supposes a close correlation between the rate of respiration and its susceptibility to carbon mon-

oxide: the higher the rate of respiration the stronger should be the inhibiting effect of a certain carbon monoxide-oxygen mixture. This in turn indicates that an argument could be furnished in favour of the theory if the rate of respiration could be raised artificially in silkworm eggs and the effect of a certain carbon monoxide-oxygen mixture upon this increased respiration would prove to be

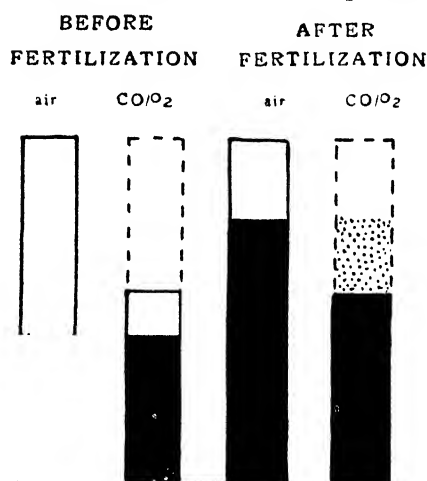


FIG. 1. Graphic representation of the theory put forward to explain the different effect of carbon monoxide on the respiration of silkworm eggs before and after fertilization. The columns represent the total amount of the cytochrome oxidase. The dark zone of the columns represents the portion which is actively engaged in the catalysis of respiration, the light zone represents the reserve. The part of the columns drawn with full lines (and jet black in the dark zone) denotes the portion of the cytochrome oxidase available for respiration, i.e. not poisoned by carbon monoxide; the part drawn with broken line (and dotted in the dark zone) represents the portion poisoned by carbon monoxide. (The total amount of cytochrome oxidase given in the graph is fictitious; probably it is greater in comparison to the part engaged in respiration, i.e. the light zone of the columns should be higher in comparison to the dark one, stronger than upon the normal rate. The possibility of carrying out this experiment was given when it was found that the treatment, by which eggs of univoltin races† are artificially bivoltinized, enhances the respiration of these eggs (see Wolsky.) The treatment consists in bathing the eggs in 50 per cent. hydrochloric acid for 10

* Contributions to the knowledge of the respiratory mechanism of silkworm eggs. IV.

† At present Principal Scientific Officer, UNESCO Science Co-operation Office for South Asia, University Buildings, Delhi.

† Races which have one generation a year.

minutes within 24 hours after they have been laid and afterwards washing them in running water for at least 30 minutes. Eggs of the univoltin race "Moretaina" treated in this way have been—after checking their oxygen uptake in air[†]—put in mixtures on carbon monoxide and oxygen and their oxygen uptake measured in these mixtures. At the same time eggs of the same race which were not treated with hydrochloric acid were also used for similar experiments to compare the effect of the same carbon monoxide-oxygen mixtures on bivoltinized and not-bivoltinized eggs. Carbon monoxide and oxygen were mixed in the ratio of 9:1 and 8:2 respectively. The measurements were made with the method described before (Wolsky⁷). Typical results of the experiments are given in Table I.

TABLE I

Oxygen uptake of not bivoltinized (control) and bivoltinized silkworm eggs in cu. mm. per hour per 500 eggs, in air and in carbon monoxide-oxygen mixtures, at 26° C. The column n gives the rate of oxygen consumption in the carbon monoxide-oxygen mixtures expressed in percentage of the consumption in air

Number of Experiment	Not bivoltinized			Bivoltinized			CO/O ₂ ratio
	Air	CO/O ₂	n	Air	CO/O ₂	n	
20/7 A	20.0	15.4	77	29.0	19.0	66	9:1
20/7 B	15.0	13.0	87	22.4	16.6	73	
10/8 A	22.4	16.0	71	36.0	24.4	62	
10/8 B	20.4	14.0	72	34.2	21.4	63	
21/7 A	20.0	21.0	100	27.0	22.2	82	8:2
21/7 B	20.0	20.0	100	26.0	20.4	78	
9/8 A	24.0	24.2	100	32.2	30.2	94	

These results show that the artificial bivoltinization with hydrochloric acid has increased the respiration in all cases quite considerably which confirms the earlier results. Indeed the increase is in some cases even greater than reported before. Together with this increase the susceptibility of the respiration to carbon monoxide also increases. Using a mixture of 90% CO & 10% O₂ the so-called residual respiration (n) expressed in percentage of the normal is about 75 per cent. for not-bivoltinized eggs but only about 66 per cent. for bivoltinized eggs. Using a mixture of 80% CO & 20% O₂ the difference becomes still more striking as

[†] Earlier experiments have shown that the oxygen uptake in a nitrogen-oxygen mixture of 9:1 is the same as in air (cf. Wolsky¹).

this mixture does not at all affect the oxygen uptake of not-bivoltinized eggs (n=100) but depresses the uptake of bivoltinized eggs (n=75 to 94). This is very nearly the same difference which we have between fertilized and unfertilized eggs. These figures definitely prove that an experimentally increased respiration becomes automatically more susceptible to CO than normal respiration and this speaks greatly in favour of the theory put forward to account for the difference in carbon monoxide-susceptibility before and after fertilization.

There is however one more point which needs some explanation. According to the abovementioned theory the limiting factor of the oxygen-consumption in carbon monoxide mixtures should be the amount of cytochrome-oxidase which is not poisoned by CO. As this must be the same both in bivoltinized and not-bivoltinized eggs (the treatment with hydrochloric acid could not have changed the amount of cytochrome oxidase in bivoltinized eggs), we should expect the rate of oxygen consumption to be lowered to exactly the same level in both kinds of eggs. But in fact this is never the case. The bivoltinized eggs although relatively stronger affected by carbon monoxide than the not-bivoltinized ones (as expressed in the lower values of n), nevertheless consume more oxygen in the CO-poisoned condition than the not-bivoltinized controls in the same condition (as the comparison of the absolute figures show). For example in Expt. 20/7B the oxygen uptake (in cu. mm. per hour for 500 eggs) of not-bivoltinized eggs is lowered by carbon monoxide from 15.0 to 13.0 (n=87). In the case of the bivoltinized eggs the oxygen consumption should have been depressed by the same treatment to the same level, i.e., from 22.4 to 13.0. But instead it is lowered only to 16.6 which figure is even higher than the oxygen uptake of not bivoltinized eggs in air, although it still means a relatively stronger depression of oxygen uptake than observed in not-bivoltinized eggs (n=73).

The deviation of the data from the theoretical expectation can have two possible explanations:

(1) In the bivoltinized eggs a certain degree of cytolysis may have set in. This is quite possible in view of the drastic treatment. According to earlier results (Wolsky²), cytolysis in silkworm eggs is connected with an increase of oxygen uptake, but

this increase is *not* susceptible to carbon monoxide (autoxydation of necrotic substances?). Thus it is possible that a cytolytic effect of the bivoltinizing treatment is responsible for the increased amount of carbon monoxide resistance respiration.

(2) It is possible that the same factor which is supposed to be responsible for the increase of the respiration catalysed by cytochrome-oxidase (*i.e.*, change in the sub-microscopic structure of the egg-cytoplasm) may have also increased some respiratory processes which are catalysed *not* by cytochrome-oxidase but by some carbon monoxide-resistant respiratory enzymes, *e.g.*, the yellow enzyme of Warburg. This explanation is in fact an additional argument in favour of our theory as it supposes that the changes in respiration are due to non-specific causes which affect more than one single enzyme system. Such an unspecific factor would be in the first line a change in the sub-microscopic structure of the egg-cytoplasm.

SUMMARY

Artificially enhanced respiration of freshly laid fertilized silkworm eggs (treated with hydrochloric acid for bivoltinization) is more susceptible to carbon monoxide than the normal respiration. The significance of

this phenomenon and the details of the results are discussed.

1. Wolsky, A., "Beiträge zur Kenntnis des. Atmungsmechanismus der Seidenspinnereier. I. Vergleich der Atmung verschiedener Entwicklungsstadien, mit besonderer Berücksichtigung der Kohlenmonoxydwirkung". *Rivista di Biologia*, 1941, **31**, 209. 2. —, "Beiträge... etc. II. Über den Sauerstoffverbrauch geschädigter unbefruchteter Eier," *Magyar Biol. Kut. Munk.* (Publications of the Hungarian Biological Research Institute), 1939, **11**, 375. 3. —, "Beiträge... etc. III. Die Wirkung der Behandlung mit Selzsäure auf die Atmung." *Magyar Biol. Kut. Munk.* (Publications of the Hungarian Biological Research Institute), 1942, **14**, 445. 4. Runnström, J., "Atmungsmechanismus und Entwicklungserregung bei dem Seeigelkeim," *Protoplasma* (Berlin), 1930, **10**, 106. 5. Brock, N., Druckrey, H., and Herken, H., "Der Stoffwechsel des geschädigten Gewebes" III. (Zugleich Beitrag zur Frage der Entwicklungserregung am Seeigelei.)" *Nauyn-Schmiedebergs Archiv*, 1938, **188**, 451. 6. Wolsky, A., "The physiology of development in Insects," *Proc. Nat. Inst. Sci. India* 1949, **15**, 67. 7. —, "The effect of carbon monoxide on the oxygen consumption of *Drosophila melanogaster* pupæ." *Journ. Exper. Biology*, 1938, **15**, 225.

SUGARCANE (*SACCHARUM OFFICINARUM*) TOP SILAGE AS FEED FOR CATTLE

N. D. KEHAR AND B. SAHAI

(Animal Nutrition Section, Indian Veterinary Research Institute, Izatnagar)

THE problem of adequate supply of nutritious fodder for livestock in India during the dry periods of the year is very baffling. After the monsoon, the cattle have to depend, for greater part of the year, for roughage supply, principally on coarse and bulky fodders like straws which are nutritionally deficient. One of the solutions of the problem seems to be in devising methods for the conservation of surplus green fodder in times of abundance, especially during monsoon months. Hay making and ensilage, if widely undertaken, may solve the problem to a great extent by providing alternative fodder of satisfactory nutritive value.

In previous articles (Kehar and Sahai, 1949; Paul and Rangaswamy, 1947) observations on the nutritive value of sugarcane tops have been reported. As already stated

the estimated yield of sugarcane tops in India roughly works out to be 16 million tons annually. At present most of it goes to waste. As this huge production of cane tops is available only during the cane crushing season extending over three to four months, it is not possible to utilise the entire produce as such for feeding cattle. The additional quantity of cane tops after meeting the requirements of the livestock in those parts will be available for conservation by a suitable method. Hence measures must be adopted to conserve the surplus material, to be utilised during periods of scarcity. The observations reported in this article relate to the conservation of sugarcane tops by ensilage and the nutritive value of the ensiled product.

Green sugarcane tops chaffed into 5" to 6" bits were filled, in pits of 8' × 5' × 4'

dimensions layer by layer. After each addition of ten maunds of green material, eight to ten adult persons trampled on the mass thoroughly for about half an hour to exclude air as completely as possible. When the green material reached a foot above the ground level, the top was covered with 6" layer of dried Bharra (*Saccharum munj*) or any other coarse hay. The pits were finally covered with earth and plastered with a mixture of dung and clay. The pits were attended to occasionally and any visible crevices due to shrinkage of the material were replastered.

After a period of four months one of the pits was opened and a representative sample was taken out. The silage was found to be of a yellowish green colour with a pleasant fruity smell.

The average chemical composition of the silage along with that of the original crop is given in Table I.

TABLE I

Chemical composition of green sugarcane tops and the silage made therefrom

	Fresh Crop	Silage
Dry matter (Percentage of fresh material)	33.86	38.25
	Percentage on dry matter basis	
Ether extract	1.33	2.07
Crude fibre	29.46	37.51
Crude protein	6.41	7.34
Total ash	8.16	9.47
Nitrogen-free extractives	54.64	43.61
True protein	4.77	4.31
Ratio true protein crude protein	0.74	0.59
Calcium (CaO)	0.59	0.71
Phosphorus (P ₂ O ₅)	0.45	0.52
pH	..	4.67
	(Stated as c.c.	N/10 per 100 gm. of fresh silage)
Total acidity	..	231.000
Amino acids	..	49.45
Volatile acids	..	81.53
Residual acidity	..	100.02
Volatile bases	..	38.05

It will be observed that the silage showed an increased percentage content of crude protein with a diminished true protein content, evidence of the breakdown of protein during the ensiling process. The chief loss would appear to have fallen on the nitrogen-free extractives, whereas fibre content was increased appreciably. Ether extract and ash content have also shown slight increase.

To determine the nutritive value of the silage, feeding experiments were carried out, using two species of animals, namely, kumauni bullocks and buffaloes. Three animals from each species were selected and put on a daily ration consisting of silage feed *ad libitum*, supplemented by rape cake at the rate of 1 lb. per animal. Besides, each animal was given 1 oz. of common salt daily. The silage was highly relished by the animals and was quite palatable. During the feeding period lasting for twenty-five days, animals kept up a healthy appearance and gained on an average 14.7 lbs. in case of kumauni bullock group and 4 lbs. in case of buffalo group.

After a pre-experimental feeding period of 15 days, a metabolism trial was carried out on animals of both the groups. Digestibility coefficients on an average were found to be crude protein 51.24, ether extract 31.81, crude fibre 61.78, and nitrogen-free extract 38.31, for the kumauni bullock group; and crude protein 49.59, ether extract 38.25, crude fibre 63.92 and nitrogen-free extract 44.01 for the buffalo group. The nutrients in lbs. per 100 lbs. of silage (dry basis) were found to be:—digestible crude protein, 3.76, total digestible nutrients, 45.115, and starch equivalent, 22.909 for the kumauni bullock group; and digestible crude protein, 3.639, total digestible nutrients, 48.633, and starch equivalent, 26.383 for the buffalo group. Table II gives a comparison of the nutrients per 100 lbs. of sugarcane top silage (dry basis) with some other common silages.

TABLE II

Nutrients in lbs. per 100 lbs. of dry matter

Name of feeds	Digestible crude protein	Total digestible nutrients	Starch equivalent
Sugarcane top silage (Kumauni bullocks)	3.76	45.12	22.91
Sugarcane top silage (buffaloes)	3.64	48.63	26.38
Jowar (<i>Sorghum vulgare</i> Pers.) silage	2.35	51.13	29.10
Maize (<i>Zea Mays</i>) silage	3.41	61.43	46.80
Spear grass (<i>Stipa</i>) silage	1.74	50.22	31.00

From the above table it will be observed that, as regards digestible crude protein, the figure for cane top silage is the highest but

as regards total digestible nutrients and starch equivalent the figures for sugarcane top silage are the lowest in the list.

Balance study for nitrogen, calcium and phosphorus was also made, the results being shown in Table III.

TABLE III

Nitrogen, calcium and phosphorus balances
(in gm. per day)

	Kumauni bullock group (average of three animals)	Buffalo group (average of three animals)
Nitrogen (N) ..	+6.48	+13.02
Calcium (CaO) ..	+0.50	+4.88
Phosphorus (P ₂ O ₅)	+1.87	+3.94

As is seen from the table, the balance for nitrogen is highly positive in both the groups. Calcium and phosphorus balances are also shown to be positive on an average.

It will be observed from the above data that ensilage of sugarcane tops will yield a fodder of high nutritive value and if recourse is taken to this method of conservation the entire surplus produce of sugarcane tops will be utilised and made available for scarcity periods, when there is a great dearth of nutritious and succulent fodder.

1. Kehar, N. D., and Sahai, B., *Science and Culture* (in press), 1949. 2. Paul, T. M., and Rangaswamy, M. C., *Ind. J. Vet. Sci. and Anim. Husb.*, 1947, 17, 48.

THIRD SYMPOSIUM ON APPLIED MATHEMATICS—ELASTICITY

THE American Mathematical Society now holds annual Symposia on selected subjects in Applied Mathematics. The subject of the first symposium, held in August 1947, was Nonlinear Problems in Mechanics of Continua. In 1948 the subject of the second symposium was Electromagnetic Theory. Both these symposia are being published in book form.

The third annual symposium was held at the University of Michigan, Ann Arbor, Michigan, from the 14th of June to the 16th of June, 1949. The subject of the symposium was Elasticity. The Applied Mechanics division of the American Society of Mechanical Engineers was a co-sponsor of the symposium. The proceedings of this symposium are to be published in book form by McGraw-Hill.

This symposium was very well attended. On the second day about 300 mathematicians and engineers from all parts of the United States were present. There were seventeen invited papers and addresses. The Chief contributors included Sir Richard Southwell, Professor E. Reissner, Professor I. S. Sokolnikoff, Professor W. Prager, Professor D. L. Holl and Professor B. R. Seth. In the Applied Mechanics division Professor S. Woinowsky-Krieger, Mr. H. Poritsky, Professor D. C. Drucker and Professor L. H. Donnell were amongst the contributors.

Sir Richard Southwell showed how his relaxation method could be used for the elasto-plastic torsion problem. Professor E. Reissner, Professor F. B. Hildebrand and Professor K. O. Friedrichs dealt with finite deflection theory of plates and shells. Pro-

fessor I. S. Sokolnikoff gave an account of methods used to solve problems in anisotropic elasticity. He showed how the perturbation method could be used to get approximate results. Professor B. R. Seth pointed out that the method implied that the anisotropic elastic constants could be obtained from the isotropic ones by adding small terms, which was not always possible. Professor D. L. Holl discussed the bending of anisotropic plates under dynamic loads.

Professor W. Prager, Professor D. C. Drucker, Professor U. Coburn, and Mr. P. G. Hodge dealt with plastic problems. Professor B. R. Seth of Hindu College, Delhi, and at present Visiting Professor of Applied Mathematics at Iowa State College, discussed some recent applications of the theory of finite elastic deformations. He criticized some papers of P. M. Riz, U. Zvolinsky R. Kappus and R. S. Rivlin. His suggestion that in the non-linear elastic domain the elastic constants should be reduced was very well borne out by papers of E. A. Davis, A. Eyring and G. Halsey, an account of which was given by C. J. Thorne. It was suggested to Professor L. H. Donnell that if these reduced values of the constants were used the wide disagreement between theory and his experimental results on buckling of thin cylinders under axial compression would become much less. Professor B. R. Seth also pointed out to Professor G. E. Hay that, in his problem of the elliptic plate under concentrated load, the use of certain relations involving stress in orthogonal curvilinear co-ordinates would enable him to obtain the solution in a closed form.

SOME EXAMPLES OF QUARTZ-GRAIN ORIENTATION IN TECTONITES AND NON-TECTONITES

SAURINDRANATH SEN

(Department of Geology, Calcutta University Calcutta)

DIAGRAMS of quartz and biotite fabric of a porphyritic granite (Manbhum), prepared in this laboratory were the first of its kind in India (Sen, 1947, 1948). The petro-tectonic interpretation of quartz axes fabric in tectonites and non-tectonites that have since been studied in this laboratory are presented in this paper. It discusses the quartz fabric of the wall rocks of the porphyritic granite in Manbhum (Sen, 1947, 1948, 1949), of sandstones, quartzites and arenaceous and argillaceous metamorphites of Darjeeling (Ray and Sen, 1948, 1949) and some quartzites from Chaibassa (Saha, 1949). The direct responsibility for both the fabric work and the interpretation, in case of the Darjeeling rocks, lies with the present author. The fabric of the Chaibassa quartzites was also studied under the guidance of the author and some of the interpretations were due to him.

Manbhum.—The fabric of 150 quartz axes

of granite gneiss from Jhanpra ($73^{\circ}11'N$, $22^{\circ}33'N$; $86^{\circ}31'E$) forming the wall of the

porphyritic granite shows a very high degree of axes concentration nearly that of a S tectonite, with little scattering in a zone intermediate between *ab* and *bc*, on the *ac* plane (Fig. 1c). The mean directions of the intersecting shear joints and the tension joints have been plotted on the *ac* fabric.

The *ac* quartz fabric of a specimen of quartzite, also occurring close to the porphyritic granite, from the north of Kotra ($23^{\circ}25'N$; $86^{\circ}27'E$) shows an apparently high statistical orientation as only 50 grains were measured (Fig. 1b). As the specimen was not oriented in the field it cannot be compared with the first diagram (Fig. 1c): it may very well fit into the first, only the

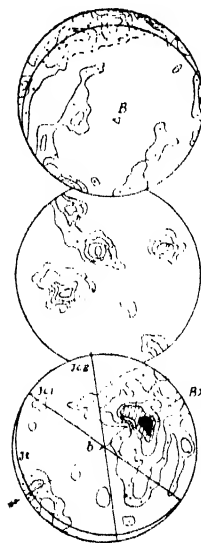


FIG. 1

Quartz Fabric (Manbhum)

A. 200 quartz axes of a quartzite from Ramchandrapur. B. Quartzite-forming wall, Kotra, 50 axes. C. 150 quartz axes of a granite-gneiss, Jhanpra.

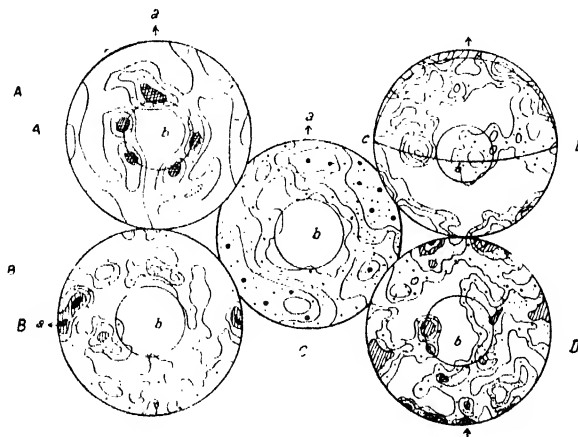


FIG. 2

Quartz Fabric (Darjeeling)

A. Gondwana sandstone, 150 axes. B. Gondwana sandstone from a shear zone, 200 axes. C. A specimen from Garnet zone 200 axes. D. Specimen 104 from Garnet zone 100 axes. E. 100 quartz axes from a kyanite-quartz rock, Kyanite zone.

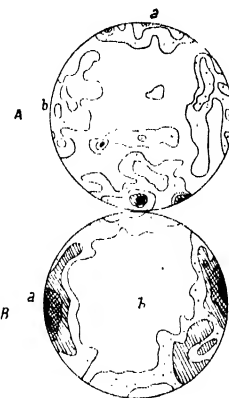


FIG. 3

Quartz Fabric (Chaibassa)

A. 60 quartz axes on *ab* of a quartzitic sandstone. B. 200 quartz axes of a quartzitic sandstone (idealised).

maximum lies closer to *b* than in the previous diagram.

The fabric of 200 quartz axes in the *ac* plane, of a quartz-sillimanite schist from near Ramchandrapur peak (23°34' N; 86°48' E) lying at an appreciable distance from the porphyritic granite, shows a well-developed peripheral *ac* girdle with a little spread along a plane intermediate between *ac* and *bc* (Fig. 1a). The specimen, coming as it does, from a region beyond an appreciable direct influence due to the intrusion of the porphyritic granite, shows the original fabric of the country rock, only slightly affected, if at all, by the intrusion.

The maximum in the first diagram lies close to the maxima VI and VII of the synoptic diagram (Fairbairn, 1944). It will be seen from the diagram (Fig. 1c) that the obtuse bisectrix of the intersecting shear joints, which has been recognised as the direction of compression (Sen, 1949) contains the maximum and is situated centrally about the distribution or the scattering of the axes.

The peripheral *ac* girdle is the original tectonic fabric. The compressive force due to the intrusion of the granite, acting in the direction of the obtuse bisectrix of the conjugate shear planes, re-oriented the fabric, without, however, affecting the original *ab* plane. The fabric has been totally reconstituted, the original *ab* plane controlling the orientation. The maximum, on these premises, is really equivalent to maximum III of the synoptic diagram. The grains were ground mechanically, with the needle axes of the ruptured grains parallel to the horizontal edge (*m* : *r*) and with their unit rhombohedral bounding face lying in the original *ab* plane (Griggs and Bell, 1938). This suggestion of mechanical rupturing of the grains is not altogether conjectural or contrary to evidences. Indeed effect of cataclastation is clearly shown by mylonitic gneisses which are quite common along the wall. "With the ruptural stage predominant in the deformation (which came to an abrupt closure) the original *ab* plane remained in tact and served as the *structure control plane* for the reconstituted fabric. The grains were fractured and the axes gathered from their original disposition (a peripheral *ac* girdle) towards the *maximum* or in other words, the needle axes were rotated parallel to *a*" (Sen, 1949).

Darjeeling.—The quartz axes fabric of rocks from successive metamorphic

zones, sandstones from the Tertiaries and Gondwana and specimens from the garnet and the kyanite zones were studied. The fabric of the successive stages reveal a progressive character which is significant. In a specimen from the garnet zone two *ac* girdles are found (Fig. 2d), one approximately 35° round *b* and the second peripheral. The first breaks up and joins with the peripheral girdle. In the higher grades the small *ac* girdle has been pushed off and only the peripheral girdle appears. The sandstones show a more perfect small *ac* girdle with only an incipient peripheral one. There is on the whole a discernible tendency for the higher grade rocks to show a more and more perfect equatorial *ac* girdle at the expense of the smaller one. The explanation put forward was that the smaller girdle is the original non-tectonic fabric which thus appears better in the underformed Tertiaries. Ingerson and Raimisch had already found a similar small *ac* girdle in Siwalik sandstones, which they ascribe to an elongation of the clastic quartz grains parallel to (1011). This fabric was at first broken down (Fig. 2c) so that beyond the complete blank 30° round *b* the quartz axes were almost equally dispersed upto the periphery. Further deformation pushed forward the axes more and more to the equatorial zone as seen in the fabric of the specimen from the kyanite zone (Fig. 1e) which shows a perfect peripheral *ac* girdle, with a slight tendency to spread into a *bc* girdle.

A beautiful field evidence of the above explanation has been found recently from the fabric of a Gondwana sandstone (Fig. 2b) coming from a local shear zone. It is seen that, though the Gondwanas show a very strong small *ac* girdle, the above specimen lacks any distinct girdle in that region, the one round the periphery being prominent, though there are a good number of axes round the 35° zone giving a semblance of the original fabric. Within the peripheral *ac* girdle there are maxima closer to *a*. A careful study of the sheared quartz grains from the same specimen reveal lamellæ in the quartz which have an orientation parallel to a horizontal edge. The lamellæ have been developed in grains whose axes fall beyond 35° zone. These are seen only in highly sheared quartz grains. This may lead to the reasonable assumption that the lamellæ formed in response to the deformation, by translation along an horizontal edge, most

probably $m : r$ (Fairbairn, 1939). The shifting of the girdle to the periphery has, thus, been performed by deformation gliding in a direction parallel to $m : r$, the translation might have occurred in any plane. The original fabric being interpreted as due to the needle axes of the clastic quartz grains lying parallel to c and bounded by unit rhombohedron, the presence of the *maxima* close to a (Fig. 2b) and the general position of the *maxima* within the small girdle, suggest a translation along a plane chiefly parallel to r .

Chaibassa.—The two specimens studied by Saha were not oriented in the field. One of these shows a normal peripheral *ac* girdle.

In the case of the second, in the small hand specimen, no distinct lineation in the *ab* plane was visible to help fixing up the b direction with certainty. The b fabric axis might have been recognized and marked out in the field, parallel to the regional tectonic strike or to some other local features like puckering and folding that might have been present, but which might have been too broad to come out in the hand specimen. Since nothing had been done in the field the interpretation has to be conjectural. In the *ab* girdle there are two *maxima* diametrically opposite. This direction has been taken to be parallel to a . For the girdle, I suggested an orientation by mechanical flattening in a deformation that was triaxial, causing an equivalent distribution close to a and b (Fig. 3a), the greater elongation parallel to a causing the *maxima* there. The *ab* girdle may, however, find other explanations. The somewhat cataclastic texture of the quartzites may support a suggestion of orientation by fracturing. There

might have been, thus, a fracturing and rotation of the grains with their (1010) needle faces rotated parallel to *ab* and the needle axes parallel to c lying in any direction on *ab*. The explanation for the *maxima* near a is as above. The explanation may also lie in the manner of fracturing, with the needle axes parallel to c and also to the horizontal edge $m : r$ with the larger percentage having the former orientation. The distribution of axes round four zones as seen in the Figure (3a) may support this suggestion. Since, however, only 60 axes were measured, the distribution may give a false picture and the true fabric may be more or less a complete *ab* girdle. In such a case as the last mechanism does not explain the girdling, the former explanations seem more plausible. Whether the orientation was by fracturing and subsequent rotation, or by mechanical flattening, perhaps by translation, is difficult to be sure of, and a more detailed work is necessary.

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CARBON DIOXIDE ISOTOPES

Infra-red spectra of the sun studied at the McMath-Hulbert Observatory, University of Michigan, have revealed the presence in the earth's atmosphere of carbon dioxide made up of the less common isotopes of carbon and oxygen. These are carbon of atomic weight 13 (C^{13}) and oxygen of atomic weight 18 (O^{18}).

The isotopes of carbon dioxide, found by Drs. Leo Goldberg, Orren C. Mohler and Robert R. McMath, are $C^{12}O^{16}O^{16}$ and $C^{12}O^{16}O^{18}$, detected in several relatively faint band structures.

In view of the difficulties that arise in the comparison of the intensities of very strong and very weak absorption lines, it is not possible at present to derive accurate isotope abundances from the line intensities. But the relative intensities of these carbon dioxide isotopes appear to be consistent with the generally accepted abundances of C^{13} and O^{18} , which are respectively 1.1 per cent. and 0.20 per cent. of the more abundant isotopes of these two elements.—(By courtesy of *Sky and Telescope*, 1949, VIII, p. 124).

OXIDATION OF LAC BY LEAD TETRAACETATE

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(Department of Chemical Technology, University of Bombay)

SINCE the introduction of lead tetraacetate as a specific oxidizing agent for adjacent hydroxyl groups in organic compounds by Criegee,¹ numerous investigators have used this reagent for establishing the constitution of a number of organic substances, particularly carbohydrates. A solution of lead tetraacetate in glacial acetic acid has also been employed for the quantitative estimation of substances containing adjacent hydroxyl groups like glycerine, mono-glycerides, sugars, etc.²⁻⁵

The possibility of lac resin containing free adjacent hydroxyl groups has been advanced by Bhattacharya.^{6,7} The constitution of aleuritic acid,^{9,10} trihydroxypalmitic acid, the chief constituent of lac,⁸ was confirmed by the work of Raudnitz, *et al.*⁹ who used lead tetraacetate for its oxidative degradation. Gidvani and Bhattacharya¹⁰ have studied the oxidation of lac by red lead in glacial acetic acid but the work was confined to the possibility of utilising the oxidized lac for industrial purposes. As the confirmation of the possibility of free adjacent hydroxyl groups being present in lac will considerably help in understanding some of the reactions peculiar to lac resin, it was considered desirable to study the oxidation of lac by lead tetraacetate.

In addition to lead tetraacetate, periodic acid and potassium periodate have also been employed as specific oxidizing agents for adjacent hydroxyl groups; while some work has been carried out with these reagents for the oxidation of lac, preliminary experiments showed that lead tetraacetate is to be preferred, as the solvent for the reagent happens to be an excellent solvent for lac also.

The lead tetraacetate was prepared according to the method recommended by McClenahan¹¹ and was stored in an airtight container, kept under anhydrous conditions. As a solution of lead tetraacetate in glacial acetic acid continuously decomposes to the more stable diacetate, the reagent was always freshly prepared; further in view of its limited solubility, only dilute solutions of the reagent could be employed and throughout the present work approximately decinormal solutions have been used.

In order to find out the optimum conditions of oxidation a series of experiments

were carried out and the effect of time, dilution, type of solvents and excess of reagent required were systematically studied. In all cases oxidation was carried out at room temperature in order to avoid secondary reactions which are known to occur at higher temperatures. Briefly the method consisted in dissolving a known amount of lac in a known volume of glacial acetic acid, adding the requisite quantity of the reagent and keeping it in the dark for a known period of time. The quantity of reagent consumed was determined by standard iodometric titration. A blank experiment without lac was also carried out at the same time. The results are expressed as milligrams of potassium hydroxide per gram of the substance in order that a comparison can be made with the hydroxyl values.

In the preliminary experiments a commercial lac was employed. Lac was ground to 40 mesh, washed with cold distilled water until free from water-soluble substances, filtered, air-dried for 24 hours and then vacuum dried over a solid dehydrating agent at room temperature for 24 hours, and stored in an airtight glass container. The results obtained with this lac are given in Tables I, II, and III.

TABLE I
Effect of time

Weight of lac 0.1000 \pm 0.0020 g. Glacial acetic acid for dissolving lac 5 ml. Amount of reagent used 10 ml.

Serial No.	Time in minutes	Lead tetraacetate value mg. KOH/g.
1	5	45.5
2	5	46.23
3	10	48.63
4	10	49.04
5	20	48.53
6	30	51.69
7	60	57.89
8	60	58.24
9	120	58.14
10	24 Hours	51.54

From the results given in Tables I, II and III, it can be seen that the maximum values are obtained when 0.1 g. lac, dissolved in 5 ml. of glacial acetic acid is treated with 10 ml. of the reagent for 60-120 minutes. Addition of solvents like carbon tetrachloride or increasing the quantity of glacial acetic acid, lac, or time beyond two hours,

gives values which are comparatively lower. The following method, therefore, can be recommended for determining the lead tetraacetate value of lac resin.

TABLE II

Effect of varying the volume of solvent

Weight of lac 0.1000 \pm 0.0025 g. Amount of reagent used 10 ml. Reaction time 60 minutes

Serial No.	Volume of glacial acetic acid ml.	Lead tetraacetate value mg. KOH/g.
7	5	57.89
8	5	58.24
11	10	51.69
12	10	51.18
13	20	40.13
14	20	41.77
15*	4	57.68
16*	4	57.44

* Contains 1 ml. of carbon tetrachloride in addition to the 4 ml. of glacial acetic acid.

TABLE III

Effect of varying the quantity of lac

Amount of glacial acetic acid for dissolving lac 5 ml.
Amount of reagent 10 ml. Reaction time 60 minutes

Serial No.	Weight of lac g.	Lead tetraacetate value mg. KOH/g.
7	0.1004	57.89
8	0.0998	58.24
17	0.2010	56.38
18	0.2002	55.20
19†	0.5006	47.60
20†	0.5004	47.61
21†	1.0008	42.39
22†	1.0060	41.27

† Contains 5 ml. of carbon tetra chloride in addition to the 5 ml. of glacial acetic acid.

All chemicals should be of the purity recommended by the B.S.S. No. 954-1941 for determination of the iodine value of lac. The reagent itself should be prepared according to the method recommended by McClenahan¹¹ unless a pure grade is available. The solution of lead tetraacetate should be matured for at least 24 hours before using.

Place 0.1 g. lac in a well stoppered flask, either 250 ml. or 300 ml., and dissolve in 5 ml. of glacial acetic acid by gently warming if necessary. When lac has dissolved, cool the solution to room temperature and add 10 ml. of 0.1 N lead tetraacetate solution and keep the flask in the dark for exactly 60 minutes with occasional agitation at room temperature. Then add 20 ml. of a 10 per cent. solution of potassium iodide and titrate the iodine liberated with 0.1 N so-

dium thiosulphate, using starch as indicator. The end point obtained is sharp; if the colour returns after 30 seconds, it should be disregarded. A blank experiment shall be carried out with all reagents in the same manner.

The lead tetraacetate value is given by the expression:—Lead tetraacetate value

(ml. thiosulphate for blank-ml. thiosulphate for lac) *

Weight of lac

* Normality of thiosulphate \times 56.1.

Using this method, the lead tetraacetate values of a number of samples of commercial lacs as well as some authentic samples of lac have been determined and the results are given in Table IV.

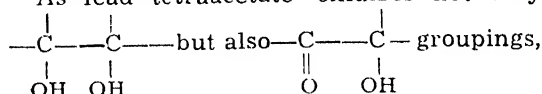
TABLE IV

Lead tetraacetate values of lac

Type of lac	Lead tetraacetate value mg. KOH/g.
* Shellac (waxy)	65.26
* Light yellow coloured shellac	54.24
* Dewaxed decolourised shellac	56.92
* Dark coloured dewaxed shellac	77.27
Washed seedlac	54.25
Dewaxed seedlac	47.65
Ether-insoluble portion of dewaxed seedlac	52.52
Ether-soluble portion of dewaxed seedlac	48.0

* Commercial samples of lac

As lead tetraacetate oxidizes not only



definite conclusion regarding the presence of any specific grouping can only be established by an examination of the products of oxidation and work along these lines is now under progress.

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LETTERS TO THE EDITOR

	PAGE		PAGE
A New Sum Rule for the Multiplet Spectra—S. SENGUPTA	333	A More Rapid Presumptive Test for Coliform Bacteria in Water—T. J. BAMAN ..	343
On the Derivation of a General Equation of Enzyme-Kinetics—A. K. RAI CHAUDHURY	334	A Study in Contrast of the Effects of Coconut Water on the Growth of Immature Embryos of Corn (Maize) when Applied Before and After Germination of the Embryo—P. UTTAMAN	343
Elastic Constants of Lithium Fluoride—R. V. G. SUNDARA RAO	336	Ergot on Bamboo—T. S. RAMAKRISHNAN AND K. RAMAKRISHNAN	344
Katabatic Effect over Jodhpur—KHAN M. SHAMSHAD	336	A Peculiar Case of Venous Abnormality in the Common Indian Frog <i>Rana tigrina</i> (Daud)—D. VAIDYANATHAN	345
A Note on Perforated Cathode Self-Quenching G. M. Counters—OM PRAKASH ..	337	The Occurrence of Starch and Its Importance as a Specific Character in Saccharum—N. L. DUTT AND R. NARASIMHAN	346
The Band Spectrum of Chromium Bromide—V. RAMAKRISHNA RAO	338	Chromosome Numbers in Some Angiospermous Plants—G. N. PATHAK, B. SINGH, K. M. TIWARI, A. N. SRIVASTAVA AND K. K. PANDE	347
Tourmaline from Devarnarsipur, Bhadravati, Mysore—M. N. VISWANATHIAH ..	339	Cultural Words of Chinese Origin: Monsoon—S. MAHDIHASSAN	347
Chemistry of Sugarcane Juice in Relation to Manufacturing Qualities—A Study with Special Reference to the Open Pan Industry—K. L. KHANNA AND A. S. CHACRAVARTI	340	The Prothallus of <i>Hemionitis arifolia</i> Sm.—A. R. RAO	349
Precis orithya Swinhoei L. (Fam. Nymphalidae) Feeding on Striga Spp.—the Phanerogamic Parasite of Sugarcane and Jowar—D. V. MURTHY AND A. S. RAO	342		

A NEW SUM RULE FOR THE MULTIPLY SPECTRA

RECENTLY a simple wave statistical representation of the spin motion has been developed by Kar-Sengupta¹ and Sengupta.² This representation has been applied to calculate the energies and intensities of doublet and multiplet spectra. The results thus obtained are in perfect agreement with those obtained by other well-known methods. In developing the theory of complex spectra, a new sum rule analogous to the well-known f - and g -sum rules has incidentally been obtained. It has been called the δ -sum rule and is applicable to the electrostatic interaction energies. It has been shown³ that the sum of the electrostatic interaction energies of all terms of same M value, arising out of any configuration of N electrons, is given by

$$\sum_{k>1} \sum_{N} E_{n_k n_p} \quad (1)$$

where

$$E_{n_k n_l} = \int \int \chi_{n_k}(i) \chi_{n_l}(j) \frac{e^2}{r_{ij}} \tilde{\chi}_{n_k}(i) \tilde{\chi}_{n_l}(j) d\tau - \int \int \chi_{n_k}(i) \chi_{n_l}(j) \frac{e^2}{r_{ij}} \tilde{\chi}_{n_k}(j) \tilde{\chi}_{n_l}(i) d\tau$$

and n_k , etc., stand for the complete set of quantum numbers $n_k l_k m_{l_k} m_{s_k}$, etc. The first Σ in (1) means summation over all possible values of $(m_{l_1} m_{s_1}; m_{l_2} m_{s_2}; \dots m_{l_N} m_{s_N})$, consistent with the condition,

$$\sum_{k=1}^N (m_{l_k} + m_{s_k}) = M.$$

From (1) it is evident that the sum of the electrostatic energies of all terms of same M value, is independent of both the coupling strength and magnetic field strength. This gives the δ -sum rule for all field. In case of weak magnetic field, this rule states, as can be easily shown, that the sum of the electrostatic energies of all terms of same J value, arising out of a given configuration

is independent of coupling. The detailed consideration of the rules and their theoretical derivation are given in another paper to be published elsewhere. It may be interesting here to illustrate the rule by considering the special case of np^3 -configuration. In this case the allowed terms are $^2D_{5/2}$, $^2D_{3/2}$, $^2P_{3/2}$, $^2P_{1/2}$, $^4S_{3/2}$. From the δ - and F -sum rules we easily get,

$$\left. \begin{aligned} ^2D_{5/2} &= 3F_0 - 6F_2 = \text{I} \\ ^2D_{3/2} + ^2P_{3/2} + ^4S_{3/2} &= 9F_0 - 21F_2 = \text{II} \\ ^2P_{1/2} &= 3F_0 = \text{III} \end{aligned} \right\} \quad (2)$$

where F_0 and F_2 are the well-known Slater-Condon notations.¹ On eliminating them from (2) we at once get,

$$\sigma = \frac{\text{III} + 2 \text{II}}{7 \text{I}} = 1. \quad (3)$$

Since the sums given in (2) are independent of coupling, the relation (3) will evidently be true in all coupling strength. In the following table we give the experimental values of σ for a number of cases, calculated from the data taken from Bacher and Goudsmit.⁵

TABLE

Element	Configuration	σ
Theoretical	np^3	1.00
7 N I	$2p^3$	1.01
7 N III	$2p^3$	0.94
8 O II	$2p^3$	0.71
16 S II	$3p^3$	0.99
33 As I	$4p^3$	1.00
51 Sb I	$5p^3$	1.02
85 Bi I	$6p^3$	0.97

The nature of coupling from $7N I \rightarrow 85 Bi I$ varies widely. In spite of this, the experimental values of σ are in agreement with the theoretical value 1 in all cases. This is, obviously, a striking confirmation of the δ -sum rule deduced from the wave statistical theory.

It is not possible to eliminate the constants and obtain a ratio similar to (3) for all configurations. This is possible only for cases where the number of equations given by the sum rule is greater than the number of constants involved. Thus for p^3s , d , d^3 , etc., configurations such elimination is possible. But since sufficient data are not available for these cases, no useful comparison with the experimental results can be made.

The proposed δ -sum rule, it is hoped, will prove of great help in the classification

of different spectra, specially those in the intermediate coupling region.

My best thanks are due to Prof. K. C. Kar, D.Sc., of Presidency College, Calcutta, under whose guidance the work has been conducted.

Physical Laboratory, S. SENGUPTA.
Presidency College,
Calcutta,
May 16, 1949

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ON THE DERIVATION OF A GENERAL EQUATION OF ENZYME-KINETICS

It has already been shown that the laws of enzyme-kinetics can be deduced from elementary considerations of the Resonance Theory previously proposed by the author (*Curr. Sci.*, 1945, **14**, 261).

In fact it was shown (*Curr. Sci.*, 1946, **15**, 130) that

$$y = S \{1 - (1 - KE)^n\},$$

where

y = Concentration of products at time t .

S = Substrate concentration (initial).

n = number of cycles performed by the enzyme molecules in course of the time t that has elapsed.

We have then put $n = At$, where 'A' is a constant and deduced the various laws for enzyme kinetics.

But it stands to reason that the different time-periods of the cycles (*Curr. Sci.*, 1946, **15**, 130) τ_1 , τ_2 , τ_3 , (1, 2, 3, ... representing the first, second, third cycle respectively) may not all be equal, i.e., when the substrate concentration becomes dilute, the time for energy exchange from the enzyme to the substrate molecules may not remain the same but be longer as the dilution is increased. We may in other words say that the time period of any one cycle is inversely proportional to the substrate concentration at that time

or,

$$\tau_1 = B/S$$

$$\tau_2 = \frac{B}{S - KE S} = \frac{B}{S(1 - KE)}$$

$$\tau_3 = \frac{B}{S(1-KE)^2} = \frac{B}{S(1-KE)^2}$$

.....

and so where 'B' is constant.

The total time t is made up of all these time periods or is $= \tau_1, \tau_2, \tau_3, \dots, n$ terms

where n is the number of cycles.

$$t = \tau_1 + \tau_2 + \tau_3, \dots, n \text{ terms}$$

or,

$$t = \frac{B}{S} + \frac{B}{S(1-KE)} + \frac{B}{S(1-KE)^2} + \dots, n \text{ terms}$$

$$= \frac{B}{S} \left[1 + \frac{1}{1-KE} + \frac{1}{(1-KE)^2} + \dots, n \text{ terms} \right]$$

$$= \frac{B}{S} \left[\frac{\left(\frac{1}{1-KE} \right)^n - 1}{\frac{1}{1-KE} - 1} \right]$$

Putting a for $\frac{1}{1-KE}$,

$$a^n - 1 = \frac{St(a-1)}{B}$$

$$\text{or } a^n = 1 + \frac{St(a-1)}{B}$$

$$\text{or } n = \ln \left[\frac{1 + \frac{St(a-1)}{B}}{\ln a} \right]$$

But we have the relation,

$$y = S \{1 - (1-KE)^n\}$$

$$\text{or, } \frac{S-y}{S} = (1-KE)^n$$

$$\text{or } \ln \frac{S-y}{S} = n \ln (1-KE).$$

Substituting the value of,

$$n = \ln \left[\frac{1 + \frac{St(a-1)}{B}}{\ln a} \right]$$

we get

$$\ln \frac{S-y}{S} = \ln \left[\frac{1 + \frac{St(a-1)}{B}}{\ln a} \right] \times \ln (1-KE)$$

But

$$a = \frac{1}{1-KE}.$$

Therefore,

$$\ln a = \ln 1 - \ln (1-KE) = -\ln (1-KE)$$

or,

$$\ln \frac{S-y}{S} = \ln \left[\frac{1 + \frac{St}{B} \frac{KE}{(1-KE)}}{-\ln (1-KE)} \right] \times \ln (1-KE)$$

or,

$$\frac{S-y}{S} = 1 + \frac{St \cdot KE}{B \cdot (1-KE)}$$

or

$$\frac{S-y}{S} - 1 = K_2 \cdot St \left[\text{const. } K_2 = \frac{KE}{B(1-KE)} \right]$$

or,

$$\frac{y}{S-y} = K_2 \cdot St$$

i.e.,

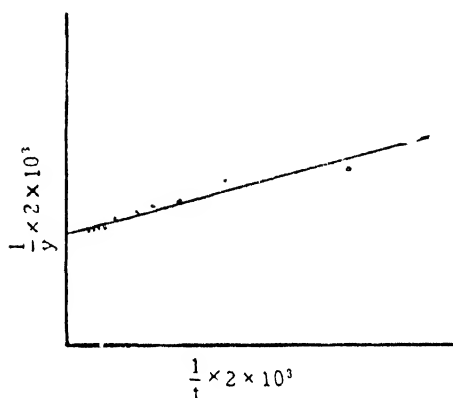


FIG. 1. Enzyme- p -amylose. Substrate—potato amylose precipitated by Butanol (not autoclaved).

From Jelinek and Harrison, *Biochem. J.*, 1948, **43**, 32.

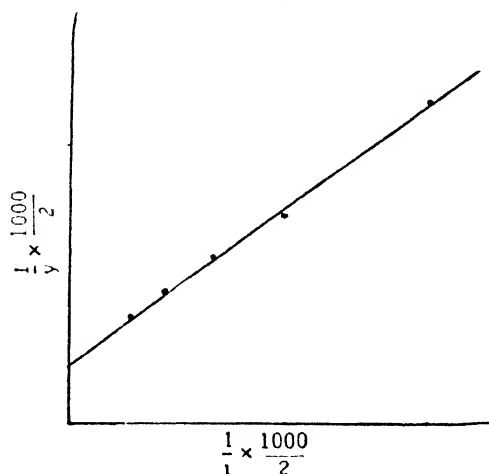


FIG. 2. Enzyme-Lipase. Substrate—monostearin.

From Bal's, Matlack and Tucker, *J. Biol. Chem.*, 1937-38, **122**, 129.

$$\frac{S \cdot (S-y)}{y} = \frac{1}{K_2} \cdot \frac{1}{t} = \frac{K_3}{t} \text{ where } K_3 = \frac{1}{K_2}.$$

or,

$$\frac{K_3}{t} = \frac{S^2}{y} - S.$$

That is, if our proposition is correct, a straight line will be obtained when $1/t$ is plotted against $1/y$ (Figs. 1 & 2). Practically all the important enzymes with uncomplicated reactions have been found to show this relation, for example, phosphatase, amylases (α and β), proteinases, lactase, lipases, etc. The detailed study will be published elsewhere.

A. K. RAI CHAUDHURY.

Bose Research Institute,
Calcutta, June 28, 1949.

ELASTIC CONSTANTS OF LITHIUM FLUORIDE

AMONG the alkali halides which show a remarkable gradation in all their physical properties, lithium fluoride is an exception in many ways. The elastic constants of the substance have been determined by Schæfer and Bergmann by the ultrasonic method of setting the crystal itself into vibrations and then using it as a three-dimensional grating to a beam of light. In view of the exceptional behaviour of the substance, it was considered desirable to repeat the measurements by other ultrasonic methods and the results of the investigation are given below:—

Lithium fluoride crystallises in the regular cubic class and has an easy cleavage parallel to the cube face. The sample used in the present investigation was artificially grown and supplied by Harshaw Chemical Company, Ohio, U.S.A. Sections (100) and (110) of different thickness (1.275–1.5 mm.) have been cut and used for the measurements. The acoustic velocities in these plates were determined by both the ultrasonic wedge method developed by Bhagavantam and Bhimasenachar (1941) and the modified plate method described by the author (1948), the frequencies used ranging from 1 to 12 mc./sec. The elastic constants were evaluated from the mean acoustic velocities. The results are given in the following table. The elastic constants c 's and the bulk modulus K are given in units of 10^{11} dynes/cm.² and the elastic moduli s 's

in units of 10^{-13} cm.²/dyne. The density of the substance is taken as 2.601 gm./cm.³

No.	Observer	c_{11}	c_{12}	c_{44}	s_{11}	s_{12}	s_{44}	K
1	Schæfer & Bergmann	11.8	4.34	6.28	10.6	-2.85	15.9	6.82
2	Author	11.9	4.58	5.42	10.7	-2.97	18.5	7.02
3	Bridgman	..	..	..	..	..	..	8.55

In the above table, the value of K obtained experimentally by Bridgman and those calculated from the relation.

$$K = \frac{1}{3} (c_{11} + 2c_{12})$$

are entered in the last column.

It can be seen from the table that for c_{11} and c_{12} the values obtained by the author are in good agreement with those of Schæfer and Bergmann. For c_{44} , on the other hand, the two values differ by about 16% which is far beyond the usual experimental error. It is not possible to give any explanation for this discrepancy. However, it is interesting to point out that the author's values are in better agreement with the theoretical Cauchy relationship, viz., $c_{12} = c_{44}$ for cubic crystals, which is found to hold good to a very great extent in the case of alkali halides.

The author thanks Prof. R. S. Krishnan for his kind interest in the work.

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Indian Institute of Science,
Bangalore, July 8, 1949.

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KATABATIC EFFECT OVER JODHPUR

JODHPUR is situated on the eastern edge of the Thar desert about 20 miles from the Luni river which remains dry during the greater part of the year. The nearest distance from the sea is about 270 miles to the S.W. The Aravalli range running NE to SW lies SE of the station at a distance of about 70 miles. Parts of the range are as high as 2,700 ft. or over. The NE end of the range descends into the desert and the SW edge is terminated abruptly at a point slightly over 120 miles south of the station near

Mt. Abu (elevation 5,650 ft.). To the North and West of the station is the semi-desert region of Jailsulmer and to the SW is the Thar Parkar region.

To the South and SSE of the airfield there is a slight downslope for about 20 miles to the Luni river. Beyond this, in the same direction, is the gradual upslope to some rolling and scattered rocky hills at a distance of 50 miles. To the SE and E is a gradual upslope to the foothills of Aravalli range followed by rapidly increasing upslope at the range. Close by in the North and West are scattered low rocky hills; to the WSW is gradual downslope to the Luni river system.

During the months of Dec. to Feb. Katabatic drainage of air from the high ground E and SE of the station is perceptible under the following conditions: (a) feeble pressure gradient, (b) clear or lightly clouded sky with dry air permitting radiation-cooling during the night. The prevailing wind over Jodhpur in winter, specially during second half of the night is dry NEly. The ground temperature starts falling rapidly after sunset becoming steady later during the night. The thermograph would have shown a smooth curve with a rapid fall at sunset and gradual stratification later, if the country were a perfect plain in the neighbourhood of Jodhpur, but due to the drainage of air from the hills in SE, there are kinks on the curve of thermograph. The kinks are followed by change in wind direction or speed and confirm the idea of Katabatic drainage from the hills.

Over the hills, cold air is collected in valleys and depressions and when during the night further cooling takes place it overflows as Katabatic wind. This Katabatic motion takes place under simple gravitational effect. When the conditions get out in para 3 are satisfied Jodhpur experiences a marked ground inversion and consequently the influx of colder air from the hills. From the photographs of anemograms and thermograms of the days when the flow was active it is gathered that when the change in wind takes place there is generally a fall of temperature by 2 to 4 deg. F. or even more at times. However, there are instances of rise in temperature by one or two deg. F. in advance of Katabatic flow. This may be due to sudden impingement of Katabatic wind upon the stratified layer of air which causes a temporary mixing or churning up and consequent rise of temperature. But

the net result of Katabatic effect seems to be cooling.

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Karachi, July 19, 1949.

*A NOTE ON PERFORATED CATHODE SELF-QUENCHING G.-M. COUNTERS

IN self-quenching Geiger-Muller counters the slope of the plateau has been attributed by Korff and Present (1944), to the occurrence of multiple pulses which are counted as spurious counts. The multiple discharges in a counter are produced either by photo-emission, that is, a photon of sufficient energy falling on the cathode ejects an electron which in turn produces a multiple pulse or by the positive ions, which, on reaching the cathode attract an electron again giving a multiple pulse. Quenching vapour has a dual role of neutralising the positive ions and absorbing the photons, though Craggs and Jaffe (1947) have shown that the absorption of photons capable of ejecting electrons from the cathode in self-quenching counters is not complete. There will thus be a certain number of spurious counts due to the photons. Also, at higher potentials the average energy and the number of positive ions being greater (Stever, 1942), there is an increase in the number of ions reaching the cathode resulting in greater secondary emission and a corresponding increase in the frequency and the multiplicity of the multiple pulses. The slope of the plateau is thus to be attributed to the increasing frequency and multiplicity of the pulses, leading to an increase in the number of spurious counts. (Putman, 1948; Wilson and Carson, 1948.) Putman has further shown that the spurious counts, which are due to secondary electrons liberated from the cathode by the positive ions are the major cause of the plateau slope in argon-alcohol filled counters.

In order, therefore, to have a good counter i.e. having a long and flat plateau (Korff, 1948) so that the counting rate remains constant even when there are large variations in the voltage applied, we must reduce the number of multiple discharges or the spurious counts. Putman has used an external quenching circuit which renders the counter inoperative after each count for a period greater than the recovery time, thus obtaining a significant increase in the flatness of the plateau.

In the present investigation we have, however, tried to reduce the number of multiple pulses in another way. It was thought that for a given size of the counter, if we reduce the surface area of the cathode, the chance of multiple pulse being produced by the photons or by the positive ions will decrease, roughly in proportion to the decrease in the area of the cathode. A counter of this type should therefore have a more flat plateau without the use of an external quenching circuit. To verify this idea two counters, out of a large number, of nearly the same dimensions (18 cm. long, 2.3-2.4 cm. diameter) one with a thin copper sheet cathode and the other with copper gauze cathode (40 meshes per inch) filled simultaneously under similar conditions at 8.5 cm. of commercial argon and 1.5 cm. of alcohol (100% pure) to a total pressure of 10 cm. of mercury, were chosen. The counting rate-voltage curves were obtained for the two counters, employing a simple circuit using a 57 tube and a 6L6 tube for working the mechanical recorder (cyclotron specialities) capable of recording 60 pulses per second. The curves are shown in Fig. 1.

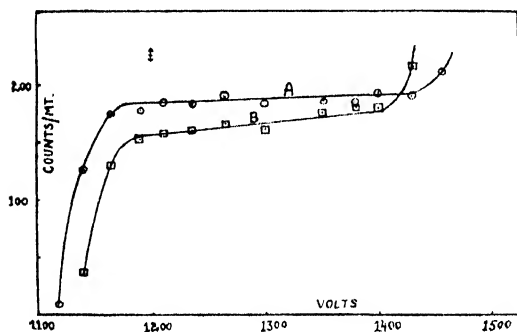


FIG. 1. Showing the Plateau curves for (A) Gauze cathode and (B) Sheet cathode counters. The arrow shows the extent of probable error.

It is clear that the plateau is definitely longer and more flat in the case of a gauze counter (plateau length, 250 volts and practically zero slope) while for the other, the plateau is smaller (210 volts) and has a considerable slope about .06% per volt. The pulse size in the two cases was observed on the oscillograph screen and it was found to be the same in two cases, i.e., the nature of the cathode has no effect on pulse size. A gauze counter is therefore an improvement as it dispenses with the use of an external quenching circuit for getting a flat

plateau. How far the gauze reduces the number of spurious counts will be definitely decided by a study (which is under progress) of the spurious pulses in the two cases. Further it may be pointed out that gauze cathode counter can be specially useful in the study of β rays where we need cathodes of practically zero thickness.

In the end the author wishes to thank Dr. P. L. Kapur, Reader in Physics, Delhi University, for his able guidance and interest in this work. Without his help this work would not have been possible. The author is also thankful to his student, Mr. S. K. Suri, M.Sc., now research officer in the National Physical Laboratory, Delhi, for helping in the initial stages of the experiment.

OM PRAKASH.

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Government College, Hoshiarpur,
(E. P.), July 11, 1949.

* The present work was completed in the Delhi University Physics Laboratory, Delhi.

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THE BAND SPECTRUM OF CHROMIUM BROMIDE

A GROUP of 16 bands (Plate A) attributable to the diatomic molecule CrBr, similar to those of CrCl,¹ is obtained in the region λ 6200- λ 6310 in a H. T. generator discharge through the vapour of specially prepared chromium bromide in a quartz discharge tube described elsewhere.² The band head data are listed in Table I, which shows also a few regularities observed among the heads. Analysis of the bands is not possible: the recurring interval of 50 cm⁻¹ might represent the characteristic and expected multiplet separation in CrBr corresponding to 40 found in CrCl previously.² The entire group may represent the $\Delta v = 0$ or 1 sequence. The low intensity of the bands frustrated all attempts to obtain them under higher dispersion, to facilitate a complete analysis.

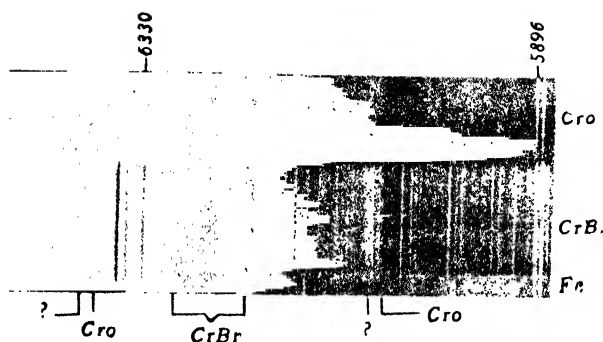


PLATE A

Chromium Bromide Bands—Glass Littrow

TABLE I
Catalogue of Cr Br Bands

Wave-length	Intensity	Wave-number	Regularities
6422.0	1	15567	}
6469.4	1	15598	
6399.8	1	15621	
6308.9	1	15846	}
6301.4	2	15865	
6296.8	2	15877	
6292.8	1	15887	
6289.8	1	15894	
6280.7	2	15917	
6275.4	2	15931	
6272.0	2	15940	
6267.0	2	15952	
6251.8	1	15991	
6247.2	1	16003	}
6243.7	1	16017	
6238.1	2	16026	
6215.6	0	16084	
6211.8	1	16094	
6198.8	2	16128	
6136.8	1	16291	

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Physics Department,
Andhra University,
Waltair, July 12, 1949.

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TOURMALINE FROM DEVARNARSIPUR, BHADRAVATI, MYSORE

IN studying an interesting type of Chlorite-Tourmaline rock from Devarnarsipur, Sri. M. G. C. Naidu has examined the Chlorite and identified it as Amesite.¹ The tourmaline of the rock mentioned as Schorlite, has now been taken for detailed study.

Under the microscope the tourmaline appears as long blades with criss-cross texture. Some rounded basal sections also occur. The colour is pale blue, and easily distinguished from the associated, pale-green, scaly amesite.

The following are the optical characters of the mineral:—

Negative Elongation

Absorption parallel to vertical cross wire

O>E

Optically Negative.

Birefringence, $\omega - \varepsilon$ 0.026 (determined by Berek's Compensator)

Indices of refraction $\varepsilon = 1.630$ $\omega = 1.655$

Distinct dichroism. X (E) = Colourless

Z (O) = Pale Blue.

The chemical composition was computed from the Variation diagram as given by Winchell.² This shows the tourmaline to be an isomorphous mixture of,

36 p.c. of Schorlite

$[H_8Na_2(Fe, Mn)_6B_6Al_{12}Si_{12}O_{62}]$

64 p.c. of Dravite

$[H_8Na_2Mg_6B_6Al_{12}Si_{12}O_{62}]$

in the proportion of 4:7 approximately.

Giovanni D' Achiardi³ has noted that the variation in the colour of tourmalines varies

with axial ratio. For example, the lowest value of axial ratio, 0.441154, is for yellow-green tourmalines, and the highest value, 0.454079, is for the yellow-tourmalines. Since crystals with the rhombohedral terminations are not found in the tourmaline under study, it is not possible to calculate its axial ratio. Therefore its relation to the colour cannot be determined.

Guido Carobbi and Renzo Pieruccini¹ correlate the colour of tourmalines with the value of double refraction; as for example $\omega - \epsilon = 0.0200$ is associated with pink, 0.0204 with colourless, and 0.0220 with greenish-yellow tourmalines. Here the value is 0.0255 and according to Winchell, this is towards the green and the blue tourmalines.⁵

From the spectrographic study, they find that lithium and copper are present in almost all samples of tourmalines from the Island of Elba and that the latter is greater in quantity in the blue crystals. As regards the blue crystals from Elba, it is suggested that copper and lithium substitute for magnesium as an isomorphous substitute. It also stated that copper in minute traces is a common substitute for the isomorphous group Mg-Fe²⁺ in the silicates of the rocks. It is therefore suggested that in the tourmaline under study, lithium and copper have substituted the Mg-Fe²⁺ of a Ferro-Magnesium mineral.

Scharizer⁶ and T. W. Warner⁷ have attributed that the change in colour of tourmaline is mainly due to the presence of minor constituents. G. Carobbi and R. Pieruccini state that the blue colour of tourmaline is due to the presence of copper and particularly due to the strongly deforming action of Cu²⁺.

The sample of the tourmaline under study was kindly analysed spectrographically by Dr. R. S. Krishnan, Department of Physics, Indian Institute of Science, Bangalore, and showed the following elements:

B, Si, Al, Fe, Mg, Cu, K, Na, & Li.

Winchell classifies the tourmaline series into Dravite-Schorlite and Schorlite-Elbaite series, the distinction between the two series being based on the presence of lithium in the Schorlite-Elbaite series and the absence of it in the Dravite-Schorlite series. Accordingly Dr. C. S. Pichamuthu⁸ describes a tourmaline from Yenneholeranganbetta as belonging to the Schorlite-Elbaite series. In regard to colour, Winchell distinguishes the Dravite-Schorlite series as being brown,

less commonly blue or green to black; and Schorlite-Elbaite series as black to delicate tints of pink, green or yellow.

Since according to the analysis of Dr. Krishnan, a persistent line of lithium has been indicated at 26708\AA the tourmaline of Devarnarsipur must be regarded after Winchell as belonging to the Schorlite-Elbaite series. But on the basis of the scheme of colour given by him, it should be put into the Dravite-Schorlite series. In view of the fact that T. W. Warner and G. Carobbi have now recently shown that lithium is present in all tourmalines and cannot therefore be a distinguishing criterion for classification, it is obvious that on the basis of the colour scheme the Devarnarsipur tourmaline should be placed in the Dravite-Schorlite series. This view is also in accordance with the fact that the copper is replacing the Mg-Fe²⁺ of the mineral and gives the blue colour associated with the Dravite-Schorlite series.

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Central College,
Bangalore, July 6, 1949.

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CHEMISTRY OF SUGARCANE JUICE IN RELATION TO MANUFACTURING QUALITIES—A STUDY WITH SPECIAL REFERENCE TO THE OPEN PAN INDUSTRY

THE important bearing of non-sugars on the manufacturing qualities of sugarcane juices is familiar in vacuum pan practice. Kortscher¹ discusses the injurious effects of various organic non-sugars in the colloidal state and Alvarez² connects superior factory quality with smaller amounts of gums and albuminoids. The so-called "harmful" nitrogen compounds³, comprising amino acids, organic bases etc., are commonly regarded as very undesirable. Various evil effects are also attributed to different mineral constituents, such as Silica, iron, alumina and magnesia^{2,4}. Gomez and Boon⁵ mention the existence of silica in the form of soluble sili-

cates as well as complex organo-siliceous compounds, the later class being also recognised by Muller.⁶ Davis⁷ makes the definite observation that organic silica is inversely proportional to juice "clarability". The question of phosphates has engaged the attention of workers in many countries, with particular reference to the variety POJ 2878, the manufacturing difficulties commonly observed being sometimes traced to phosphate deficiency^{4,8,9,10,11,12,13} though not always explained on this basis^{14,15,16,17,18}. Effective phosphates have been postulated such as phosphates present as phosphoric acid,¹⁹ or those in true solution.²⁰ Davis (*loc. cit.*) discovers a characteristic phosphate status in the clarified juice of a variety (leading to possibilities of organo-phosphates) and concludes that a better criterion is the residual phosphate level or the amount of phosphates eliminated.

The part played by non-sugars under the drastic treatments of the white sugar factory being thus clear, their greater importance in the open pan system need hardly be stressed. Large varietal differences in gur quality are a matter of common experience, marked variation in respect of non-sugars in juices of different varieties having also been observed.^{21,22,23} It, therefore, becomes important to evaluate varieties for the open pan industry with regard to the nature and extent of non-sugars in their juices as also to assess the role of these ingredients in determining quality of the product.

In these experiments, eight important cane varieties (in four replications) were examined, the juices being analysed for Pol, reducing sugars, total colloids, gums, pectin, total organic nitrogen, "harmful" nitrogen, ash, SiO_2 , $\text{Fe}_2\text{O}_3 + \text{Al}_2\text{O}_3$, CaO, MgO and P_2O_5 . Most of the analytical methods have been referred to in previous communication,²⁴ "harmful" nitrogen being estimated by the method of Unverdorben and Spielmeyer.²⁵ Gur was prepared from each juice under rigidly standardised conditions (striking point: 118°C .), which were considered satisfactorily reproducible, as evident from—(i) Uniform temperature gradients (measured from 105°C onwards) in all cases, (ii) constancy in gur/juice ratios in respect of Pol, reducing sugars and ash for all pans boiled, (iii) constancy of the ratio between colorimetric index per 100 Bx. in gur (measured in standard solution) and

the same quantity for juice, for a particular variety and juice treatment. A classification of the gur samples (on general features, Pol, reducing sugars, ash, nett rendements, colour, acidity and insoluble matter) distinctly pointed to Co's 313 and 513 as good gur varieties, Co 453 as poor, the rest being medium.

Analytical data pertaining to the juices revealed striking differences between Co's 313 and 513 on the one hand and Co 453 on the other, the behaviour of the rest being intermediate between the two. Thus, Co 453 juices (poor) on an average, showed higher values for the undermentioned ingredients or ratios over those of Co's 313 and 513 (good), the order of percentage difference being shown against each in brackets:

- (i) Total colloids (130), (ii) Ash (40), (iii) Ash in colloids/Total ash (50), (iv) Gums (70), (v) Pectin (80), (vi) Harmful N (60), (vii) Harmful N/Total organic N (75), (viii) Soluble SiO_2 (145), (ix) $\text{Fe}_2\text{O}_3 + \text{Al}_2\text{O}_3$ (100), (x) CaO (80), (xi) MgO (50).

In contrast to the above, Co 453 juices exhibited lower values for P_2O_5 content, being of the order of 30 per cent. below those for Co's 313 and 513. The important role of non-sugars in the open pan industry is thus clearly brought out. Further work is in progress.

The work was conducted as part of the Sugarcane Research Scheme in Bihar, being financed jointly by the Government of Bihar and the Indian Central Sugarcane Committee, to whom grateful thanks are due.

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Station, Pusa (Bihar),
May 25, 1949.

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PRECIS ORITHYA SWINHAEI L.
(FAM. NYMPHALIDAE), FEEDING ON
STRIGA Spp.—THE PHANEROGAMIC
PARASITE OF SUGARCANE AND
JOWAR

In 1946 August, one of us (D.V.M.) noticed a number of butterfly caterpillars feeding on *Striga*-Spp.—a root parasite of sugarcane and jowar in this tract. The caterpillars on rearing emerged into butterflies, provisionally identified as "*Precis Orithya Swinhæi*" L., popularly known as "Blue Pansy". During the same period the caterpillars were noticed on *Striga* in some of the sugarcane plots at Rudroor, and later during winter months, at Bodhan and nearby places.

Striga Spp.—the root parasite of sugarcane is a fairly serious pest in the Nizamsagar tract and during August 1939, Rai Saheb Prof. L. S. S. Kumar of the Bombay Agricultural Department, visited the area on tour and suggested various remedial measures for the eradication of the pest. In his report¹ he alludes of having noticed a butterfly caterpillar feeding on *Striga densiflora*. It is not known whether it is the caterpillar of *Precis Orithya Swinhæi* L. he is referring to.

The butterfly, though observed all the year round, is abundant only during the winter months. The seasonal distribution is as follows (see Table I).

During the months of December 1948 and January (1949), when rearing was done in the laboratory, its life-history was as follows:

Egg period 4-5 days, Larval period 10-15 days and the Pupal period 10-12 days. The

meteorological data in the laboratory where rearing was done is given in Table II.

TABLE I

Month	Caterpillars collected during field observations round about Bodhan	Butterflies noticed
October	22	In few numbers
November	120	In large numbers Flitting during midday & copulating
December	112	Do
January	53	In few numbers
February	12	Do. Observed on <i>Striga</i> in <i>Kabi</i> jowar plots
March	nil	In very few numbers
April	3	In negligible numbers
May-October	Almost nil	In very negligible numbers

TABLE II

Average meteorological data of the
Laboratory where rearing was done

Month	Maximum Temp.	Minimum Temp.	Humidity
December '48 ..	78.3° F.	72.2° F.	65
January '49 ..	78.9° F.	70.9° F.	66

The eggs of the butterfly are laid singly on tender leaves and buds and the caterpillar feeds on them. However the caterpillar is not a voracious feeder. The effectiveness of the butterfly in reducing infestation of *Striga* is being worked out.

Apart from the above a few more insects on *Striga* have been observed. Investigations will be carried as and when opportunity arises.

Thanks are due to Prof. Rai Saheb L. S. S. Kumar and Dr. Md. Qadiruddin Khan for kind help.

D. V. MURTHY.

Sugarcane Entomo. Lab., A. S. RAO.
Department of Agriculture,
Bodhan (Deccan), June 9, 1949.

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A MORE RAPID PRESUMPTIVE TEST FOR COLIFORM BACTERIA IN WATER

THE findings of Mallimann and Darby¹ were utilized in devising a rapid test for coliform bacteria in water by Sandholzer and Quimby.² For this test a medium of the following composition is recommended:

Tryptose	..	20%
Di-potassium hydrogen phosphate	..	4.0%
Potassium dihydrogen phosphate	..	2.0%
Duponol*	..	0.1%
Potassium nitrate (nitrite free)		1.0%

* Obtainable from Ashe Laboratories, London.

As tryptose was not available in India (or even U. K.) a modification of the above medium was necessitated; it was observed that Stearns peptone could effectively replace tryptose and that it is better not to mix sulphonilic acid with alpha naphthylamine after their preparation in the dark bottle as was recommended by the above workers. Results obtained by this method on two hundred samples of raw, settled, filtered and chlorinated water were compared with those recorded by MacConkey's Bile Salt Neutral Red Lactose broth method of water analysis.³ The results reveal (see table below) that there is no significant difference between them and those by the above authors. It is therefore obvious that peptone can be conveniently used in place of the more expensive tryptose.

TABLE I

The comparison of nitrate reduction test for coliform bacteria with the standard method and with the results obtained by Sandholzer and Quimby.

No. of samp. tested*	Nitrite positi- ve confirmed*	Reaction in Duponol-Peptone Medium Tested after :							No. of samp tested†	Nitrite positi- ve confirmed†
		6 hrs.	8 hrs.	10 hrs.	12 hrs.	14 hrs.	24 hrs.	48 hrs.		
4	4	+	+	+	+	+	+	+	0	0
54	54	-	+	+	+	+	+	+	26	26
27	27	-	-	+	+	+	+	+	13	13
20	20	-	-	-	+	+	+	+	18	12
1	1	-	-	-	-	+	+	+	8	3
26	4	-	-	-	-	-	+	+	7	2
11	1	-	-	-	-	-	-	+	8	1
57	0	-	-	-	-	-	-	-	20	0

* Tested by the present author on MacConkey's Bile Salt Neutral Red Lactose broth as per standard method, and on Duponol Peptone as a test medium.

† Tested by Sandholzer and Quimby on Brilliant Green Lactose Bile salt broth method as standard method and on Duponol-Tryptose as a test medium.

The author is indebted to the staff and especially to Mr. George Fylinto, B.Sc., of the Public Health Laboratory, Poona, for the co-operation.

Fergusson College,
Poona 4,
August 19, 1949.

T. J. BAMAN.

1. Mallimann, W. L., and Darby, C. W., *Am. J. Pub. Health*, 1941, **31**, 127.
2. Sandholzer, L. A., and Quimby, F. H., *Jour. of Bact.* 1945, **50**, 105.
3. Ministry of Health No. 71 (1936).

A STUDY IN CONTRAST OF THE EFFECTS OF COCOANUT WATER ON THE GROWTH OF IMMATURE EMBRYOS OF CORN (MAIZE) WHEN APPLIED BEFORE AND AFTER GERMINATION OF THE EMBRYO

IN an exploratory experiment to find out the effect of natural extracts on the growth of a two-week-old corn embryo, it was observed that these extracts exercised some depressing effect upon the germinating embryo; in other words, it took a longer time for the embryo to germinate in the culture medium when in contact with the extract than when it was absent. The natural extracts tried were cocoanut meal extract and young corn ovule extract. A similar depressing effect was observed in the case of cocoanut water (Uttaman,¹ 1949). To examine this phenomenon more critically and, incidentally, to seek an explanation thereof, the following experiment was set up.

Two-week-old corn embryos were used. The treatments consisted of:

1. Cocoanut water applied at the time of placing the embryo in the medium.
2. Cocoanut water applied the next day when the embryo had just started germinating.
3. Control.

Tukey's medium plus active growth promoting ingredients used in culturing very young embryos of corn in a previous experiment (Uttaman,² 1949) was used for culturing these embryos. Each treatment was replicated three times and growth measurements for shoot and root were made for the same embryo continuously for five days. The results are entered in the table below. The method of application and the quantity applied, of cocoanut water

was the same as in the previous experiment to find out the effect of cocoanut water on the embryo growth.

Embryo placed in the medium on 8-9-1947

Replication	Date of measurement	(1)		(2)		(3)	
		Cocoanut water applied at the time of placing the embryo in the medium		Cocoanut water applied next day when the embryo had just started germinating		Control	
		Shoot mm.	Root mm.	Shoot mm.	Root mm.	Shoot mm.	Root mm.
1	9-9-47	Not germinated		2.0	0.5	1.2	1.5
	10-9-47	6.5	1.1	12.9	1.2	13.7	16.8
	11-9-47	13.4	1.1	27.2	1.2	29.5	23.1
	12-9-47	24.4	1.1	36.1	3.0	44.8	31.0
	13-9-47	31.9	1.2	40.2	3.0	46.5	36.2
2	9-9-47	Not germinated		2.2	1.0	1.3	1.3
	10-9-47	5.9	3.5	11.5	1.8	14.3	13.3
	11-9-47	5.9	3.5	26.8	3.0	37.3	30.3
	12-9-47	33.3	3.5	38.6	3.0	59.3	37.6
	13-9-47	35.3	3.6	44.4	3.0	69.2	40.4
3	9-9-47	Not germinated		2.5	0.5	1.1	1.0
	10-9-47	Just germinating		12.5	1.2	13.0	16.5
	11-9-47	3.4	Nil	31.0	1.2	31.9	29.4
	12-9-47	3.4	Nil	44.4	2.4	46.9	35.5
	13-9-47	3.4	Nil	Fungus attack		54.3	44.5

From the above results it will be seen that the embryo in treatment 1 failed to germinate on the second day and that the growth of the embryo is more marked when the cocoanut water is applied after the embryo has germinated than when applied before the germination.

Discussion.—The reason for the differential behaviour in the growth of the embryo in the case where cocoanut water is applied before as compared with after the germination of the embryo might be found in the hypothetical suggestion that by the time the embryo starts to germinate the embryo factors decompose into certain toxic component parts which depress the germinating embryo and that most part of the opportunity to benefit by the embryo factors, is lost to it. That the loss of the embryo factor activity due to heating, chemical treatments, standing, etc., may be due to a release of toxic substances which inhibit the growth of the embryo has been demonstrated in the case of *Datura* by

previous workers (Van Overbeek, 1942; Van Overbeek, Conklin and Blakeslee, 1941).
Agric. Res. Institute, P. UTTAMAN.
Coimbatore, July 15, 1949.

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ERGOT ON BAMBOO

In May 1949, several clumps of *Bambusa* sp. near Gudalur (Nilgiris) were found affected by a peculiar disease. From the apices of several shoots whitish to dark brown elongated, curved or twisted sclerotoid bodies up to about an inch in length had formed. These projected out of the sheaths of the topmost leaves. Some of them were covered with a creamy white semisolid mass similar to what appears in the sphacelial stage of *Claviceps*.

Sections of the sclerotoid bodies showed that the core was white made up of a compact mass of hyphal cells. Towards the periphery a dark layer was evident all around the sclerotium. External to this layer the hyphal plexus gave rise to labyrinthine folds and depressions lined by palisade-like cylindrical conidiophores which abstricted conidia one after another. The conidia were elongated, spindle shaped, hyaline, one celled and measured $7 \times 3 \mu$ ($4-10 \times 2-4$). They germinated when floated on water giving rise to germ tubes mostly laterally.

The hyphae permeate the young tissues of the stem at the tip of the branch. On coming out of the tissues they formed a whitish basic stroma eccentrically placed between the sheaths and the stem on the side where the sheath opened. Originating from this base was the elongated and often twisted sclerotium which was white in the initial stages but developed a dark greenish brown colour on the outside as it became older. Longitudinal fissures were formed in older sclerotia. The sphacelial stage formed a creamy deposit on the surface.



FIG. 1. Sclerotia on the shoots



FIG. 2. Section of sclerotium with sphaelial formation

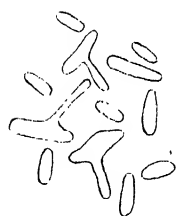


FIG. 3. Conidia, three germinating ($\times 850$)

The characters of the sphaelial stage and the sclerotium lead one to identify the fungus as a species of *Claviceps*. The peculiar odour felt while handling sclerotia of *Claviceps purpurea* Tul. was present to a large extent in fresh sclerotia. When the sclerotia were powdered and assayed traces of alkaloids were found to be present. These suggest that the fungus is a *Claviceps*. This genus of fungus has been so far observed to infect flowers only. In

the present instance there was no flower formation and the infection was confined to the apices of the shoots. The sclerotia were washed and placed in moist and in petri dishes for ten days at 5° C., and again at laboratory temperature for over two weeks. But there was no evidence of germination. Tempere (1933) has recorded infection of flowers of *Phyllostachys puberula* (nigra) by *Claviceps purpurea* from France. But the fungus under study is not *Claviceps purpurea* as is evident from the nature of the conidia. This is the first record of an ergot infecting vegetative shoots of bamboo from India.

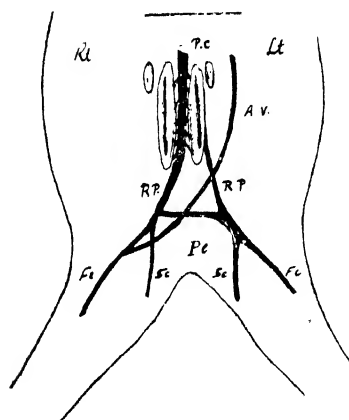
T. S. RAMAKRISHNAN.
K. RAMAKRISHNAN.

Mycology Section,
Agri. Res. Institute,
Coimbatore, July 19, 1949.

1. Tempere, G., *Biol. Absr.*, 1933, **10**, 1875 (original not seen).

A PECULIAR CASE OF VENOUS ABNORMALITY IN THE COMMON INDIAN FROG *RANA TIGRINA* (DAUD)

THE right renal portal instead of entering the substance of the right kidney takes a downward bend and joins with the post-caval. Apart from this, the pelvic given off by the right femoral is continued as the abdominal in the absence of its fellow from the opposite side.



On the left side, the femoral and the sciaatic unite to form the renal portal which after running for a short distance gives off a branch that pass transversely to join the left renal portal. The left side is also

conspicuous by the total absence of the pel-
vic.

Department of Biology,
Bhavan's College, D. VAIDYANATHAN.
Andheri. Bombay, July 22, 1949.

THE OCCURRENCE OF STARCH AND ITS IMPORTANCE AS A SPECIFIC CHARACTER IN *SACCHARUM*

DURING the course of the study on sett and shoot-root formation last season, it was noticed that sett-roots were formed late in the Burma form of *S. spontaneum* while in the variety Katha belonging to *S. Barberi* the sett-root formation was both early and profuse. It had been shown by Carlson² that shoots of roses grew much more rapidly and developed a more vigorous root system if the nodes of the cuttings from which they grew showed starch accumulation. Sections were therefore cut both in the case of Katha and Burma *spontaneum*; there was more starch accumulation in the stem of Katha than in Burma *spontaneum*.

Went (quoted by Onslow⁴) observed that much starch is present at first but it gradually disappears forming hexose. After growth ceases, the hexose is diminished and sucrose accumulates. Alfaro¹ and later Haddon³ noticed that in cane grown in acid soils there was accumulation of starch while that grown on alkali soils showed no starch. This aspect of the question was later studied by Weller⁵ who came to the conclusion that two distinct types of starch accumulations occur in the cane plant. The first type occurs only above the nodes in the first two or three layers of parenchyma cells surrounding the vascular bundles. He observed this in H. 109 grown in both acid and alkaline soils. The second type occurs in all of the parenchyma cells and he observed it only in Natal Uba. He further pointed out that these accumulations of starch were suggestive of causes of varietal variation in the rooting habit of cane.

It occurred to the present authors that why Went did not notice starch in the fully grown internodes was may be because he was dealing with only *S. officinarum* varieties and why Weller noticed starch in Uba was that this might be characteristic

of *S. sinense*. A few varieties belonging to the species of *S. officinarum*, *S. spontaneum*, *S. Barberi* and *S. sinense* were examined and it was found that there was practically no starch in *S. officinarum* varieties. On the other hand there were relatively large quantities of starch in *S. Barberi* but only traces to small quantities in *S. spontaneum* while *S. sinense* came in between *S. Barberi* and *S. spontaneum* with regard to the accumulation of starch. The presence or otherwise of starch as seen in transverse sections of the four species of *Saccharum* is shown in the micro-photographs in Plate I. These sections were taken from the bottom-most internode.

PLATE I

Accumulations of Starch in the stem of *Saccharum* species

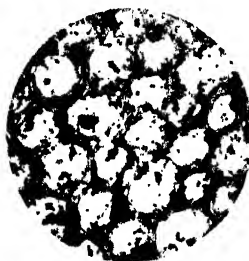


FIG. 1
Katha (*S. Barberi*)

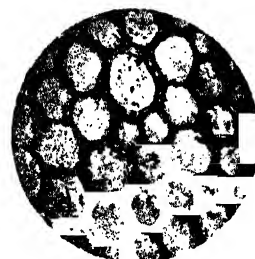


FIG. 2
Uba (*S. sinense*)

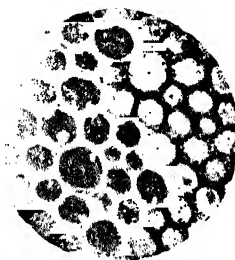


FIG. 3
Coimbatore (*S. spontaneum*)
× 150

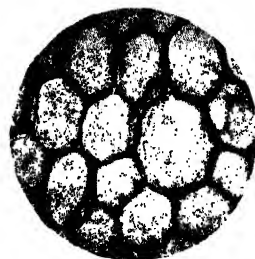


FIG. 4
Vellai (*S. officinarum*)

The above observations were then extended to the other varieties in the Collection. Seventy-eight varieties of *S. officinarum* have been studied and in all of them there has been no accumulation of starch except in ten varieties in which traces or very small quantities of starch have been

observed in the top portion of the stem. Eightyfive varieties belonging to *S. Barberi* have been studied and in almost all of them a relatively large accumulation of starch has been noticed both at the base of the stem and at the top portion. Examination of 25 varieties belonging to *S. sinense* showed that in most of them the quantity is not so much as in *S. Barberi* but a fair quantity is present in all excepting 3 or 4 in which only traces have been met with. Twenty-six varieties belonging to *S. spontaneum* were studied and only small quantities of starch were noticed, though in 8 or 9 types a fair accumulation but lesser than in *S. sinense* and much less than in *S. Barberi* was noticed. Preliminary observations were also made on other genera and it was noticed that there was no starch accumulation in *Sclerostachya* and *Narenga*, while starch has been noticed in Guinea grass (*Panicum maxicum*), Napier grass (*Pennisetum purpureum*) and Sorghum. Eight types of *Erianthus* have been studied and fair to large quantities of starch accumulation were noticed.

The observations have been restricted to the fully formed portions of the stem. Sections were taken at two points (1) at the bottommost joint above the ground and (2) the joint at the top next above the dead leaf joint, i.e., the oldest functioning green leaf. These observations were made on almost fully matured crop of about 11 months growth.

These studies are being continued. The indication at present is that the presence of starch in the fully formed internodes is a definite specific character for certain species of *Saccharum*. It is hoped to extend the studies to the numerous inter-specific and inter-generic hybrids at the Station to ascertain how this character is modified in these.

Sugarcane Breed. Station,

Coimbatore,

July 26, 1949.

N. L. DUTT.

R. NARASIMHAN.

1. Alfaro, Ann. Conf. Cuban Sugar Tech., 1928.
2. Carlson, M. C., Bot. Gaz., 1929, 87, 64.
3. Haddon, E., South African Sugar Journal 10, 629.
4. Onslow, M. W., "The Principles of Plant Biochemistry," 1931, 25.
5. Weller, D. M., Hawaiian Planters Record, 1929, 3, 294.

CHROMOSOME NUMBERS IN SOME ANGIOSPERMOUS PLANTS

ACCORDING to the information of the authors, the chromosome numbers reported here are new.

*The morphological features of *Justicia adhatoda* Linn. is so different from other species that it was kept under a separate genus as *Adhatoda vasica* Nees. Its haploid

MELIACEAE			
<i>Melia azadirachta</i> Linn.	2n=28	Pathak & Singh	
POLYGONACEAE			
<i>Rumex dentatus</i> Linn.	n=20	"	
APCYNACEAE			
<i>Allamanda grandiflora</i> Hook.	n=9	Pathak & Tiwari	
<i>Tabea mentana coronaria</i> Willd.	n=11	"	
<i>Thaetia nerifolia</i> Juss.	n=9	"	
SIMURACEAE			
<i>Albathus cyclosa</i> Roxb.	n=31	Pathak & Srivast	
<i>Polantes aegyptiaca</i> Delile	n=9	"	
STERCULIACEAE			
<i>Croton acerifolium</i> Willd.	n=19	"	
<i>Sterculia colorata</i> Roxb.	n=20	"	
ACANTHACEAE			
* <i>Justicia adhatoda</i> Linn.	n=17	Pathak & Pande	
<i>Erantemum variegata</i> Linn.	n=21	"	
<i>Decalacanthus nervosus</i> T. Anders	n=21	"	
BIGNONIACEAE			
<i>Talcia pentaphylla</i> Gomez	n=20	"	
<i>Jacaranda mimesifolia</i> D. Don.	n=33	"	
RUTACEAE			
<i>Murraya exotica</i> Linn.	n=9	"	
EBENACEAE			
<i>Diospyros embry. pteris</i> Pers.	n=15	"	

chromosome number 17 as compared to 14 of other species confirms this separation.

G. N. PATHAK.
B. SINGH.
Govt. Agri. College, K. M. TIWARI.
Kanpur, A. N. SRIVASTAVA.
January 3, 1949. K. K. PANDE.

CULTURAL WORDS OF CHINESE ORIGIN: MONSOON

THE following information has been summarized from Yule¹ and Burnell, almost in their own words: "Monsoon is the name given to the periodical winds of the Indian seas—The original word is the Arabic *Mausim*, season, which the Portuguese corrupted

into Moncao and English into Monsoon. It had the sense of periodical winds among Arab pilots from whom the Portuguese adopted the word. The Turkish Admiral, Sidi Ali, writes that Mausim as a word is used for anything that comes round but once a year like the festivals. In Lebanon Mausim is the season of working with the silk, in Yemen the season of navigation." What we do realise, even today, is that monsoon represents rain more than wind and unlike wind or a rainy shower which is capricious in its nature, monsoon comes so regularly every year that the time of its visit can be predicted even beforehand. This singles out monsoon as a special phenomenon.

It is self-evident that a knowledge of the monsoon must have greatly helped navigators of the Indian Ocean. R. Sewell² says that the regularity of monsoon in the Indian Ocean was discovered in B.C. 47 when Alexandria was taken by Julius Caesar. It was only after this discovery that ships began to sail direct to Malabar. But this can only refer to Indo-Roman trade and it is more probable that the Romans then acquired this knowledge directly from foreign pilots rather than by discovering the phenomenon for the first time. Here we may inquire about the maritime trade between India and the Far East and the knowledge of monsoon possessed by Eastern pilots that brought ships to India?

J. Kennedy³ writes that "from the history of Chinese coinage it can be shown that an active sea-trade sprang up about 700 B.C. between Babylon and the East and that India had an active share in it". If the Chinese came to Babylon and sailed through the Indian Ocean they must have had precise knowledge of the monsoon and must have planned their voyages accordingly. What the Romans came to know second hand at about 50 B.C. the Chinese must have had first hand about 700 B.C.? This date strikes as rather early. According to Pelliot, as cited by Laufer, in his *Sino Iranica*, p. 543 "the earliest date we may assume for any navigation from the coasts of Indo-China into the Indian Ocean is the second century B.C.". Even this suffices for our purpose for the question can be raised, how did the Arabs, rather late in the history of navigation, happen to be the first to designate the monsoon of India such that

their name alone has become almost universal? If the Chinese sailed in the Indian Ocean during the second century B.C. what was their name for the monsoon. Above all it is natural to expect that the rainy season of India should have had a Sanskrit term. But this seems secondary to those who, living in India, have expressed a far more precise knowledge of the phenomenon through their "Mrig Nakshtra" which actually gives the date, when the rainy season begins. In this light only the incoming foreign sailors, uninitiated in such knowledge and deeply impressed by the regularity with which the monsoon begins, have given it a designation connoting the rainy season, for nothing like it exists elsewhere.

Apart from all secondary meanings attributed to it we must admit that monsoon signifies the rainy season. It comes regularly, to use Sidi Ali's terminology, like an annual festival. On the contrary, Mausim, as an Arabic word, merely connotes a season and not any special rainy season. Moreover the word Mausim is derived from the root Vasm, given by Platts,¹ on p. 1090, as meaning "to describe"; "to excel in beauty". How a word to "excel in beauty" can give rise to a derivative signifying the rainy season special to the Indian Ocean can be appreciated only by philologists who have divorced all love for physical geography. I have shown before how such a far fetched etymology can be replaced by a common-sense explanation once we look upon it as a loan word. Monsoon in Chinese at once represents the phenomenon expected of the word.

Giles,⁵ gives Character No. 7693, as Mao, meaning a period. It does not express a duration as in the phrase "period of a year". Instead it is used in phrases like "the fixed dates at which the muster is made" and "the morning bell in a monastery", where the beginning is precisely indicated. Character No. 275 is Chan, translated as "a soaking rain". A phrase using this word is translated as "wet to the skin" which is expected alone of a soaking rain. These two words give rise to the term Mao-Chan, a period of heavy rains, or better heavy rains, which come annually and begin at the expected time for which Mao would be the right word. B. Karlgren,⁶ in item No. 602, translates the Cantonese pronunciation of

the word Mao as Mau, and in item No. 1163 Chan as T'sin. Thus Mao-Chan in Cantonese becomes Mau-Tsim which the Arabs could not have transliterated better into popular tongue than as Mau-Sim. Like typhoon, monsoon represents features of its own. As opposed to the capricious nature of rain and wind, monsoon is as regular as an annual festival. This regularity makes it conspicuous as a type. Typhoon, which is a dreadful wind, is used in terms like Tufan-Mail, meaning a very fast mail train, simply because the happier side of its nature represents its speed. Likewise Mau-Sim, the period of heavy rains, is extended to express a season which begins with as much respect to the time of the year as the monsoon of the Indian Ocean does, being then a compliment to such a season. While the secondary meanings of the term Mau-Sim have varied, the primary one, as a period of heavy rains, has been fully retained in the word monsoon even to this day.

SUMMARY

Monsoon, the English word, comes from the Portuguese, Moncao, which is derived from the Arabic, Mausim. This word has the root, Vasm, meaning nothing better than "to excell in beauty". Yet Monsoon is considered to be a derivative from this Arabic root. On the contrary, the Chinese term Mao-Chan, means a period of heavy rains. This term in Cantonese is pronounced Mau-Tsim which was transliterated into spoken Arabic as Mau-Sim. The Arab pilots learnt of Mausim from Chinese sailors. As a Chinese term alone Monsoon becomes a genuine connotative word.

Ciplas,
Bombay,
August 15, 1949.

S. MAHDIHASSAN.

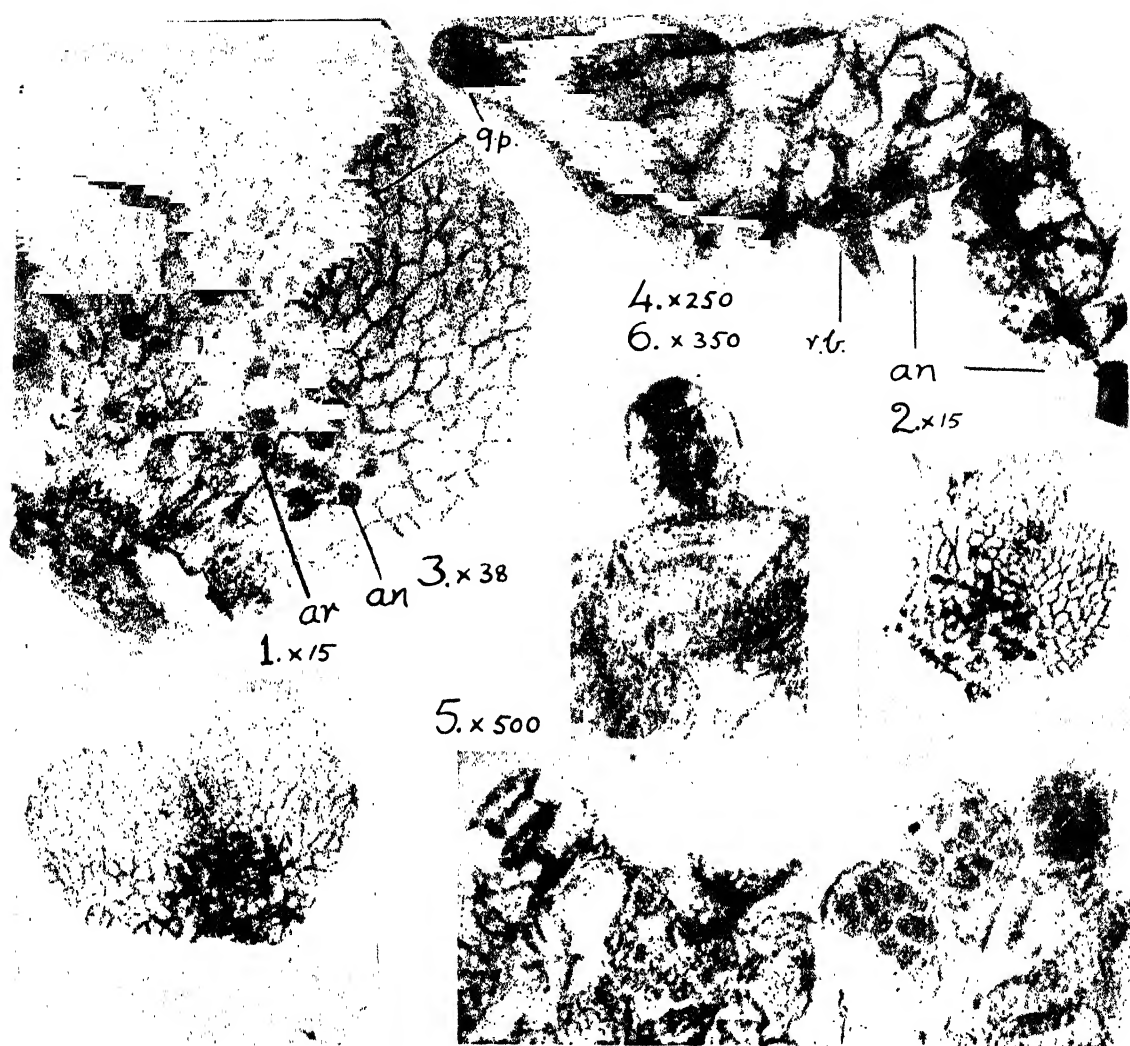
Giles, H. A., *A Chinese-English Dictionary*, 1892. 6. Karlrger, B., *Analytic Dictionary of Chinese and Sino-Japanese*, probably 1923.

THE PROTHALLUS OF *HEMIONITIS* *ARIFOLIA* Sin.

THIS xerophytic fern belonging to the Polypodiaceæ grows abundantly in South India, at slight elevations and generally between rock crevices and damp brick walls, etc. A brief account of the sporophyte and its anatomy has already been published (Rao, 1946). The prothallus of this fern was however not easily found. Attempts to artificially germinate the spores did not succeed as the spores found on fertile leaves were not sufficiently ripe enough. This year however, Sri K. Subramanyam, Central College, Bangalore, kept a careful watch for these prothalli and succeeded in securing a few which are now being described.

The prothalli were found growing gregariously amongst moss protenema on moist substrata in the crevices of rocks. A few young plants obviously derived from old prothalli were also found along with the gametophytes, often attached to them. The adult prothalli are monoecious, comparatively small in size, 3-4 mm. broad, dark green in colour and typically cordate and bilobed (Photos 1-3). Often the prothallus presents a trilobed appearance (Photo 2) probably a modification of the fundamentally bilobed condition due to environmental factors. The growing point is only one even if the prothallus is trilobed, and is situated in the median notch as usual (Photos 1-4). Both the sex organs are equally well developed and occur together (Photo 5) on a small cushion on the underside only, so far as has been observed. The antheridia are round, numerous and appear to be as in other members of the Polypodiaceæ (Photo 4). The archegonia are short and show just three tiers of cells (Photos 5 & 6). There appears to be only one neck canal cell as in the Polypodiaceæ. So far as could be made out no mycorrhiza is associated with the prothallus. To the best

1. Yule and Burnell, *Hobson-Jobson*, 1903, 577. 2. Sewell, R., "Roman Coins in India, *J.R.A.S.*, 1904, 591. 3. Kennedy, J., "Early Commerce of Babylon with India," *J.R.A.S.*, 1898, 241. 4. Platts, J. T., *A Dictionary of Urdu, Classical Hindi and English*, 1911. 5.



Hemionitis arifolia Sm. Explanation of photographs

1. Bilobed prothallus seen from the underside showing median notch, sex organs and rhizoids. 2. Trilobed prothallus seen from the underside showing rhizoids, sex organs, and a single growing point located in the median notch. 3. The lower surface of the specimen seen in Photo 2 photographed on a large scale to show the growing point (*g.p.*), antheridia (*an*) and archegonia (*ar*). 4. A free hand section of the prothallus passing in the median plane. The growing point (*g.p.*) is seen on the left; the rhizoidal bases (*rt.*) and a row of antheridia (*an*) can be seen on the lower side. 5. Part of another freehand section of a prothallus showing three antheridia on the right, each showing sperm mother cells, and probably a tangentially cut archegonium on the left. 6. An archegonium showing three tiers of cells.

of my knowledge the prothallus of this species of *Hemionitis* has not been described so far. A detailed study of the prothalli will be published elsewhere.

Department of Botany,
Lucknow University,
July 15, 1949.

A. R. RAO.

Rao, A. R., *Curr. Sci.*, 1946, 15, 141-42.

REVIEWS

Advances in Protein Chemistry, Vol. III.

Edited by M. L. Anson and John T. Edsall,
(Academic Press Inc., New York, N.Y.
1947. Pp. xii+524. Price \$7.50.

This third volume in the series will be eagerly welcomed by all investigators interested in proteins. Of the 11 contributions, nine of them originate from American Laboratories; this bears eloquent testimony to the rapidly growing schools of protein chemistry which are establishing themselves in the States.

Braunstein who discovered the phenomenon of transamination reviews the subject of transamination in relation to protein metabolism and discusses the integrative functions of the dicarboxylic acids. The main object of the article has been to "summarise the present knowledge of this metabolic process and to sift well-established facts from erroneous or doubtful conclusion due to imperfect experimental technique and to premature generalisations". This is an opportune contribution of fundamental interest.

The preparation and the physical magnetic and immunological properties of the coloured iron-containing ferritin and colourless and iron-free apoferritin are described by Michælis in the second review. Adsorption analysis of mixtures of amino acids is the subject of a stimulating review by Tiselius who has pioneered the development of this useful and highly promising analytical tool. Henry B. Bull has presented a useful summary of the papers on protein monolayers; this is followed by a review on Films of protein in biological processes by Alexandre Rothen. The chemical determination of proteins is the subject of a review by Paul L. Kirk.

Roger M. Herriot has presented a comprehensive and critical review on the reactions of native proteins with chemical reagents, a field of study in which those interested in the elucidation of the structure of proteins in relation to their biological activity would be particularly interested. The subject has other applications e.g., the modification of the undesirable properties of certain proteins so that they may be used medicinally and the conjugation of carcinogens to proteins for the purpose of producing antisera. Nutrition chemists will be deeply interested in the review on the amino acid requirements of man by Anthony A. Albanese. A useful summary of our knowledge regarding

the symptoms of amino acid deficiencies in man, has been included. Closely allied to this is a review by Robert Elman on the use of protein and protein hydrolysates for intravenous alimentation. Attention is drawn to the fact that large peptide molecules could be more rapidly and more efficiently utilised by certain types of tissues than small peptides and single amino acids. This raises the question of the degree of digestion of proteins which would secure for the hydrolysate the highest possible nutritive potential.

The last two reviews relate to (1) the preparation and criteria of purity of amino acids by Max S. Dunn and Louis B. Rockland and (2) the plasma proteins and their fractionation by John T. Edsall. The newer methods of fraction described in the review will be of inestimable value to all protein chemists.

Proteins dominate every field of Biochemistry and the ADVANCES in this fundamentally important branch will appeal to a wide circle of investigators covering both biophysics and biological chemistry including medicine.

Fundamental Processes of Dye Chemistry.

By H. E. Fierz-David and Louis Blangey.
Translated by Paul W. Vittum from the 5th
edition of *Grundlegende Operation der Far-
benchemie* (Springer-Verlag, 1943; Inter-
science Publishers, New York), 1949 Pp. 479.
Price 9.50 dollars.

Grundlegende Operationen der Farbenchemie, first published in 1922 and revised in 1938 and 1943, has been the standard book on the subject. The Fifth Austrian edition of this useful book has now become available in English. The book consists of six parts: intermediates, dyes, technical details, analytical section, analysis of commercial dyes, and determination of light fastness.

The first part includes a brief survey of some of the unit processes of organic synthesis; these are described as "operations" although it is more usual to restrict the latter term to the unit operations of chemical engineering such as filtration and evaporation. An excellent account is given of the isolation and purification of dyestuff intermediates, together with tests for the purity of the products. The discussion of orientation rules which follows is one of the unsatisfactory features of the book. This might well have been omitted from a prac-

tical manual, but if its inclusion was considered necessary, there must have been some indication of the theory of aromatic substitution. One of the few important carbazole intermediates is 2-hydroxycarbazole, and in the account of orientation in the carbazole series the route to this substance through carbazole-2 : 3 : 6 : 8-tetrasulphonic acid is not mentioned. There is also no reference to the synthesis of carbazole derivatives of definite orientation by the dehydrogenation of tetrahydrocarbazoles, which are readily obtainable from the appropriate cyclohexanonephenylhydrazones. It is stated that the nitration of toluene gives a small percentage of *m*-nitrotoluene, but not that this is isolated commercially and used for the manufacture of *m*-toluidine and *m*-cresol. The "theoretical" section on diazonium coupling gives no indication at all of the mechanism of the reaction; a brief explanation would have rendered the behaviour of various diazonium salts and coupling components easier to follow. The authors prefer to speak of diazo compounds, rather than diazonium salts. Dealing with 1-amino-2-naphthol-4-sulphonic acid, it is not mentioned that the product of diazotization is a diazo-oxide. The function of pyridine in coupling is much more complicated than that of a solvent or an acid fixing agent, and it needs in fact to be investigated.

The most valuable part of the book is the description of detailed procedures for the laboratory preparation of dyestuff intermediates of the benzene, naphthalene and anthraquinone series. The preparation of each intermediate is followed by "technical observations", in which the manufacturing method, precautions to be taken, type of reaction vessels used and the applicability of the process to other intermediates are outlined. Diagrams of laboratory set-ups are supplied for many preparations.

Part II, which follows the same pattern as the section on intermediates, describes preparative methods for a few dyes of the azo, diphenylmethane, triphenylmethane, azine, thiazine, anthraquinone, indigoid, sulphur and phthalocyanine series. In the "technical observations", dyeing and fastness properties are briefly discussed. Although the authors have clearly stated that the book is not an encyclopedia but a laboratory manual for the beginner in dyestuff chemistry, the omission of some intermediates and dyes of great importance is to be regretted. Examples are benzanthrone, stabilized diazonium salts, mixtures of the latter with azoic coupling components used as print-

ing compositions (Rapid Fast and Rapiptogen types), preformed metal-dye complexes of the Neolan type, and dyes for cellulose acetate. Naphtol AS is not mentioned, but curiously enough Naphtol AS-ITR is. While vat dyes are in many ways the most important group among the synthetic colouring matters only two, Indanthrene Blue RSN and Indanthrene Yellow GK, are included; the second has now become nearly obsolete, and its preparation, which is merely the benzylation of an amine, is simple. Dyes such as Caledon Jade Green and Indanthrene Khaki GG are of much greater interest, both chemically and commercially. At least one example of a solubilized vat dye (Indigosol and Soledon type) should have found a place. The statement that "the Bohn-Schmidt reaction is of little importance technically" (p. 60) is surprising. 5-Aminosalicylic acid is erroneously mentioned as *p*-amino-salicylic acid (p. 156). The wealth of extremely valuable information on the German dyestuff industry which has now become available in B.I.O.S. and F.I.A.T. reports is dismissed airily with the remark that the methods described in the book before these reports appeared are largely similar to I.G. processes, and where they are different the authors' procedures are preferable for laboratory purposes. To quote only one example among many, the B.I.O.S. process for 1:4-diaminoanthraquinone from quinizarin is much to be preferred to the method described in the book (p. 230).

Parts IV (Analytical Section) and V (Analysis of Commercial Dyes) give the impression of being put together hastily from the previous edition with little attempt to bring the material up to date. Chromatography gets a bare mention, and there is no reference to such methods as the titration of acid dyes with basic dyes and the purification of azo dyes by means of potassium acetate or di-*o*-tolylguanidine. Part VI gives an account (by Dr. H. Ris) of light fastness; other equally important fastness properties are not mentioned. References are restricted almost entirely to Fierz-David's books and papers and to German patents. *Organic Syntheses* and some recent manuals of practical organic chemistry contain a considerable number of dyestuff intermediates, and references to them would have been useful to students for whom this book is intended. The printing is excellent and the diagrams are clearer and better drawn than in the Austrian edition. However, several errors in printing have been noticed—e.g., 3 instead of 8 in p. viii; ref. 9 in p. 410; the fourth line from the bot-

tom in p. 334; NH missing from the formula for Helindone Brown in p. 460; and the peculiarly bent bond in the structure for Indanthrene Olive R. The constitution assigned to Helindone Brown is that of Indanthrene Yellow 3R.

K. V.

Principles of Electricity and Electromagnetism.

By G. P. Harnwell. (McGraw-Hill Book Company, Inc.), 1949. (New Second Edition). Pp. xvi + 670. Price \$ 6.

The first edition of the book under review was published over a decade ago in the International Series in Pure and Applied Physics. This earlier book has now been thoroughly revised in the light of the many recent important contributions to electrical theory and practice. The present new edition should make a special appeal to the advanced students of electricity, who will recognise in it an admirable text-book.

The book presupposes that the student is already quite familiar with the groundwork of physics and more especially of electricity and magnetism. The fundamental and classical electric phenomena are properly stressed, and the study of electrical power and communication engineering as well as of electrical devices and measuring techniques has also received its due emphasis. As the recent developments in electronics and the atomic and nuclear physics profoundly influence the physical basis of electrical theory, adequate stress has been laid on these and allied phenomena. Students, on whose part a greater familiarity with atomic physics is assumed, are initiated into the study of the physics of the conductivity of solids, the magnetic behaviour of atoms and nuclei and high energy ion-accelerators.

After presenting the fundamental principles of electrostatics in the first two chapters, the consideration of the physical characteristics of dielectrics and conductors is taken up in the third. The fourth chapter deals with direct current circuits and is followed by a chapter on non-ohmic circuit elements and alternating currents. Developments in the theory and use of thyrite and thermistors have justified the long discussion on non-ohmic elements. Though it must be admitted that the consideration of alternating current springs up rather earlier than usual, it seems to arise naturally out of the greater importance of the non-linear elements in connection with alternating rather than direct currents and more especially in the field of communication engineering. After a consideration of the chemical, thermo-electric and

photoelectric effects, Chapter VII gives a complete treatment of the thermionic vacuum tubes and the cathode-ray oscillograph. The chapter on electrical conduction in gases is well developed and ends with a discussion on counters. The belated chapter on electromagnetic effects of steady currents takes up, in addition to the classical problems, the consideration of the magnetic resonance accelerators, mass spectrometers, magnetrons and such other appliances. Similarly the tenth chapter on electromagnetic induction gives the theory of the betatron and discusses the magnetic characteristics of atomic systems leading on to a technique originated by Stern and Gerlach for measurement of atomic and nuclear magnetic moments. The discussion of the magnetic properties of matter in Chapter XI leads on to the description and the theory of electromagnetic machinery. Chapters XIII to XVI are devoted to simple L-R-C circuits, coupled circuits, vacuum-tube circuits and propagation of electromagnetic radiation. These last chapters outline the fundamentals of radio engineering in theory and practice, and the presentation of the subject is both concise and clear.

The mathematical treatment throughout the book is vectorial and the necessary background of the general vector theory is developed in the Mathematical Appendix, which includes also a brief mention of the methods of Fourier Analysis and Differential Equations. A special feature of the book is the provision of numerous problems at the end of each chapter. These problems, which on the aggregate number more than four hundred, are designed to help the student to gain a thorough grasp of the subject.

The happy mingling of the classical and modern outlook in electricity set forth in this book renders it a welcome up-to-date text-book for the Honours and the post-graduate students, who have not at present too many capable text-books on the subject of electricity and electromagnetism.

L. S.

Introduction to Physics. By Harley Howe. Second Edition. (Published by the McGraw Hill Book Company), 1948. Pages 600. Price \$ 4.5.

In the preface to the book the author says that originally the text was prepared for the author's large classes of non-technical and pre-medical students, students of agriculture and of liberal arts. It may be said that the author has been successful in this task. A lot of at-

tention has been devoted to the selection of topics that have to be studied by College students (not merely those who specialise in Physics) in these days when Physics has become very important both in peace and in war. Incidentally, the book may be recommended for use by students in India who take up the courses mentioned above.

The book, intended to serve the above purpose, uses no mathematics beyond elementary algebra and plane geometry; however, students desirous of making a further study of the subject can find in it a solid base on which they can build. The book contains a number of examples and a good many illustrations carefully chosen.

The intention of the author is to help the student to develop a scientific approach to experience rather than present him merely with an account of facts. The Introduction makes this clear. Attempt has been made to emphasize that the subject is intimately related to experience. This is very welcome as in these days when the numerous specialised treatises that appear make it hard even for a "physicist" to realize that the most abstract mathematical theories found in Physics are forced on us by experience. Further the forty-five chapters of the book should tell one story and not forty-five, says the author. This is a point to be clearly grasped by many who are expositors of the subject. The book shows how attempts can be made with success even in introductory books on the subject.

D. S. SUBBARAMAIA.

Cosmic Ray Physics. By D. J. X. Montgomery. (Published by the Princeton University Press, Princeton, New Jersey. Pp. viii+370. Price \$5. Agents in India—Oxford University Press). Price Rs. 17-8.

This book is very largely descriptive and is written to suit the needs of the experimenter. It is based largely on the notes of the lectures of Professor M. Schein of the University of Chicago. The purpose of this book is to enable a person to gain a knowledge of this specialised field expeditiously so as to obtain an overall view of the subject. There are copious references which, according to the author are representative and not exhaustive.

The book commences with an introduction to the present status of cosmic ray investigation. An attempt is then made to explain the principles underlying the operation of cosmic ray apparatus and this is followed by a description of the experimental methods in cosmic rays.

Subsequently, there are chapters on the intensity of cosmic rays, the hard component, the soft component and the heavy particles in cosmic radiation. The exposition is throughout lucid and the book gives a very readable account of this field of knowledge. Unfortunately, the author does not attempt to go into details. This limits the use of the book to our undergraduate students of experimental physics. Even a student of experimental physics requires a knowledge of the circuits employed in cosmic ray work and this information is lacking.

The reviewer would congratulate any person who can really attempt to write a good book on this subject in our present state of knowledge and technique. Under the circumstances, the following few remarks may be offered without in any way undermining the utility of the book for general reading. The choice of the material has been a little arbitrary. Some of the criteria developed are not quite correct. To define the hard component and to define it as something which can go through 10 cm of lead is not very desirable.

The appendices are very useful. The Störmer theory, the definition of intensities, the results of the statistical theory of showers, pressure-altitude tables, curves connecting the momentum with energy loss and range in different materials etc., are all very useful. The printing and get-up of the book are excellent. There are a large number of figures and they are carefully chosen and well drawn. The photographs are very well reproduced.

The book can be most heartily recommended as a very useful addition to our college libraries.

S. V. CHANDRASHEKHAR AIA.

A Study on Mine Surveying. By Sri. S. K. Dhar. (Chotanagpur Industries Ltd., Dhanbad), 1949. Pp. 130. Price Rs. 8.

The book under review deals in a precise manner with a large number of topics from calculation of areas and volumes to the subsidence in mines. A noteworthy feature of the book is that the author has worked out in detail a number of illustrative and very instructive problems. Under each chapter the author has enumerated a number of alternative methods and formulæ that could be employed to solve a particular problem.

Another salient feature of the book is the inclusion of just the amount of theory to enable the students to follow intelligently the several problems worked out in detail. But the theory given under some chapters such as "Tacheometry", "Contouring" is too brief to

enable a student to follow these chapters fully. The usefulness of the book can be enhanced by including topics such as description of the surveying instruments such as levels theodolites, tacheometers, and their temporary and permanent adjustments.

The author may also add, with advantage to the mining students, such topics as continuation of Survey lines, Transference of levels to the underground from the surface, alignment of centre lines of shafts and similar specific applications.

The inclusion of chapters on "Checking Calculations", "Logarithm tables" have enhanced the usefulness of the book though the subject matter has been dealt with rather too briefly.

The book has been got up neatly, and I have no hesitation in saying that it serves admirably the needs of students taking various examinations in mine surveying as well as of young people just entering the profession.

The book will also be a good addition to a technical library where a concise book setting forth the fundamental ideas in mine surveying is needed.

S. R. PRASAD.

Conditioned Reflexes and Neuron Organisation.

By Jerzy Konorski, Head of the Department of Neurophysiology in Nencki Institute of Experimental Biology and Professor in the University of Lodz. Translated from the Polish MS. under the author's supervision by Stephen Garry. Cambridge Biological studies. Printed at the University Press, Cambridge, 1948. Pp. xiv+267. Price 18 sh.

The physiology of the nervous system has developed along two lines, one by the Sherringtonian and the other by the Pavlovian school. Sherrington has put forward a certain general conception of the functioning of the central nervous system. Broadly speaking, this conception consists in basing the functioning of the central nervous system on its neuron organisation, in laying down that the nervous system acts as a single integrated whole. He carried out an analysis of the interaction of reflexes, indicating the manner in which they participate in the coordination of the organism's activity. The problems of integrative action continued to be studied in many laboratories, but gradually problems in this field have been exhausted and advances have made comparatively less progress from the position which was reached in Sherrington's first monograph. This is chiefly due to the fact that investigations on this subject did not include the main integrating organ, the cerebral cortex.

An extensive investigation of the cerebral activity was undertaken by Pavlov with the aid of the method of conditioned reflexes which he created and which constituted a separate and independent line of enquiry. These two schools of thought however, have not met on common ground, so that, whereas the Sherringtonian concept has spread all over the world and is now studied in many scientific centres and schools, and its achievements have become a generally recognized acquisition of physiological knowledge, the other has so far hardly passed outside the bounds of the school which created it, and remains isolated from the other department of physiology, though it is closely related to it.

In this book, the author has therefore undertaken to extend Sherrington's conception of the functioning of the nervous system to the field of higher nervous activity, on the basis of the experimental material collected by the Pavlov school, as he considers the Sherringtonian conception built upon the basis of investigation of lower nervous activity superior to that created by Pavlov to explain cortical phenomena. In this he has taken the right step. The facts collected by the Pavlovian school have been systematized and explained on the basis of the conception and data of neurophysiology. The system which can thus be developed, being a logical complement of the system of physiology of lower nervous activity will make it possible to lead the science of conditioned reflexes out of the dead end in which it is at present and thus lead to further development in both the fields. Such a combination was urgently needed, and the author has done a great service to neurophysiology and is to be congratulated on the successful way in which he has accomplished the task.

INDERJIT SINGH.

An Introduction to Comparative Biochemistry.

By Ernest Baldwin. (Macmillan & Co., Ltd., London), 1948. Pp. xvi+164. Price 7 sh. 6 d.

This book does not need any introduction to students of biochemistry. Its popularity and excellence can be gauged from the circumstance that it has gone through three editions in a decade.

Students taking up the study of a science, before they are flooded with detail, should be helped to survey its aims and scope widely, i.e., they must have an integrated view of the science. To this end, as Prof. Hopkins points out, "the book contributes in admirable fashion"; moreover, "from the highly diffuse literature

of comparative biochemistry, Dr. Baldwin has selected for his lucid exposition with skill and judgment".

The two-fold aim of the author, to provide an elementary text-book for students of biochemistry and to provide a starting point for those, who, for any reason, might feel attracted to this subject, has been fully realised. He has, to quote Prof. Hopkin's words "dealt with its different aspects in nice proportion. He has illustrated very adequately in relatively few pages, many of the main lines of progress, leaving in the mind of the reader no doubt concerning their significance. Above all, he has, I feel, displayed his own interest in the subject, an interest intense enough to be infectious".

The whole text has been revised, extended and brought up to date: a new section on the transport of carbon dioxide has been added to Chapter VI and a new Chapter VIII has been introduced to cover some of the broad and comparative aspects of nutrition, digestion and metabolism; adding to the usefulness of the book.

The table of classification will be helpful to those not familiar with zoology. A very useful bibliography and a helpful subject index distinguish this volume. The get-up of the book maintains the standard expected of the well-known publishers.

M. R. R.

Propagation of Trees, Shrubs and Conifers.
By Wilfred G. Sheat. (Published by Macmillan & Co., Ltd., St. Martin's St., London), 1948. Pp. 479. Price 25 sh. net.

This book is a comprehensive manual which treats of the various methods of propagating and multiplying the numerous classes of plant material in constant demand in nursery practice. It is not a mere discussion of theories from an academic standpoint, but is intensely practical from cover to cover. It describes in simple language and full detail the different methods of propagation in current use among nurserymen in England with reference to each of the genera and species dealt with. When more than one method is employed as in the case of certain plants, all such methods are described in the order of their popularity or success. Where different methods are applicable at different times of the year or under different seasonal conditions, these are also indicated, together with a correct appraisal of the merits and demerits, if any, of each, so that the reader who proceeds to make use of the knowledge imparted may employ in practice

the method best suited to his own conditions and requirements.

Angiosperms; Part II (pp.404-448) treats of the

Part I of the book (pp.3-403) deals with propagation of Conifers. At the end is added a section which gives useful tables and other miscellaneous information on classification of soils, weights and measures, etc.

The range of material dealt with is limited in the main to the classes of plants cultivable out-doors in a temperate climate but includes also some of the kinds that have to be raised under glass. The propagator who wants to employ the same methods under tropical or sub-tropical conditions can profit by the information only in so far as those methods indicate the underlying principles on which the practice is based.

The author has not dwelt on the more recent methods of propagation based on the use of hormones and other chemical substances probably for the reason that some of them are regarded as being still in the experimental stage. We may well expect therefore that a book so dependably practical will soon go into a fresh edition and include a chapter on these revised practices which are fast coming into use.

B. S. NIROY.

Elsevier's Encyclopaedia of Organic Chemistry, Volume 12B. Naphthalene. Edited by F. Radt. Pages 1-344. (Published by Elsevier Publishing Co., Ltd., Distributors: Cleaver-Hume Press; Price for subscribers to whole work, £ 6-5sh.)

This well printed and sturdily bound documentary publication forming volume No. 12B of the set of 20 volumes of Elsevier's Encyclopaedia of Organic Chemistry deals with compounds containing one naphthalene nucleus. The contents of this volume have been grouped under two main sections *viz.*, (1) Hydrocarbons and (2) Halogeno-Compounds. The section on Hydrocarbons is further divided into sub-sections as (1) Naphthalene and its hydro-derivatives and (2) Naphthalene and its hydro-derivatives with side chains. The section on halogeno-compounds is also divided into two sub-sections as (1) halogen inside chain and (2) halogen attached to the nucleus. General literature up to and including 1944 and the literature concerning the structure up to 1948 of more than 500 naphthalenic compounds have been incorporated in this volume.

In addition to the 344 pages of chemical literature, the volume contains a 30-page des-

criptive part dealing with a general survey of the encyclopaedia, general outline and notes on its use, and containing a table of abbreviations and a table of periodicals. Further it has a 12-page subject index and a 10-page formula index. The publishers have also issued a list of 'Additions and corrections' as also a set of notes entitled 'Discrepancies in the literature' in the form of loose sheets, which is not happy as they are apt to be lost. Publication of these notes and corrections with additional literature available up to date as supplementary volume to the respective original volume, at convenient intervals, may be more useful.

The enormous accumulation of literature on the ever-increasing multitude of organic compounds has to be collected, classified and presented in a manner easily accessible to the research worker so that further advance could be made avoiding repetition and duplication. Being the first compilation of its type in the English language of the world literature on organic compounds, Elsevier's Encyclopædia should be a welcome addition to the reference library of any institution engaged in organic chemical research.

B. H. IYER.

The Report on the Socio-Economic Conditions of the Aboriginal Tribes of the Province of Madras. Edited by Dr. A. Aiyappan. (Govt. Press, Madras), 1948. Pp. 185. Price Rs. 2-2.

The Report under review is a document of considerable interest. The recommendations made for the welfare of the people may be commended on the whole. There is a laudable stress on the need of caution in changing the life of the aboriginals. For example, "podu" cultivation "should not be stopped suddenly". The Report speaks very strongly about the schools in aboriginal areas which are described as "mere apologies" for schools, very bad and dirty copies of the schools of the plains, betraying complete lack of imagination. The Report's remarks on Prohibition are sensible and moderate. It is suggested that a limited number of trees may be allowed to be tapped on condition that the toddy is to be used only for absolutely essential religious purposes. There is a wise suggestion that the simple marriage customs and freedom of women, "since their all healthy practices which civilized Indian communities are aiming at," should not be interfered with. Similarly the Report deprecates interference in the food habits of the people.

There is a strong recommendation for the extension of anthropological studies which might well be followed by the Universities of Southern India.

In short, the general outlook of the Report is intelligent and humane, but the descriptive part might have been of a higher standard.

B. S. G.

Annual Report of the Director, Technological Laboratory, for the year ending 31st May 1948. Indian Central Cotton Committee, Post Box No. 1002, Bombay. Price 6 annas.

This interesting report of the activities of the Cotton Technological Research Laboratory of the Indian Central Cotton Committee, Bombay, gives a bird's-eye-view of the useful work done by the Laboratory during 1947-48 and the remarkable progress it has achieved since its inception nearly 25 years ago. The report running to 70 pages is conveniently given under various heads like Spinning, Testing House, Fibre testing, Research, Ginning, Publications, etc., facilitating ready reference. Statistical data giving details of samples received for spinning and other tests from Industrialists and Agricultural Departments all over the country reveal the increasing utility of the Laboratory and its standard technique to the country and the growing demand on its services. It would be no exaggeration to say that the steady improvement in the quality of the Indian cotton crop is as much due to the expert assistance of the Laboratory as to the patient work of the breeders. The Report gives results of tests on a number of improved strains which are quite in keeping with the spirit of the times bear attractive names like Jawahir, Subhas, Suyog, Vijay, etc. Besides these, the Laboratory maintains records of certain typical Indian cottons from all over the country grown under standard conditions year after year, which serve as a standard of reference, and cover "nearly 52% of the total area under Cotton Cultivation" (page 35).

The Testing House is another useful activity of the Laboratory serving as an impartial agency to declare quality. With the introduction of labelling of textiles and standardisation of quality, which we hope the country will soon adopt, this should serve as the watch-dog of the Industry and consumers' interests.

The most important part of the Laboratory's work—Technological Research is summarised in 17 pages (42-59) and repays careful study. A summary of several investigations on problems of ginning including the device of a new gin

and a new balance for determining ginning percentage, fibre quality in relation to mixtures, twist and yarn strength, neps and fibre quality, prediction of spinning quality from fibre particulars, cellulose sheets from linters, etc., are given. An important advancement reported is the micro-spinning technique — standard spinning process for a 60 gm. sample (as in Giza Station) and the fineness measurement by air permeability (similar to Hertel's method) which should be of considerable utility to the Industry. A summary of the paper on maturity coefficient for Indian Cottons—an improvement over Peirce and Lord's formula, is given.

The list of publications from the Laboratory as also the additional equipment purchased with details of staff, etc., are included. While it is an impressive record of the vast amount of valuable routine and research work accomplished by the Laboratory the reviewer feels that it is necessary to expand considerably its sphere of activities, so that research on industrial problems,

problems of immediate and remote application in spinning, weaving, finishing, etc., are tackled by the Laboratory on the lines of the Shirley Institute instead of tabooing weaving and finishing as at present. Concentration on original research, either fundamental or applied, would perhaps in the long run be of greater benefit to the country.

If the textile industry of independent India should stand world competition, research on every aspect, from the growing of the raw material to the manufacture of the finished product and its marketing, is essential. While the Laboratory deals principally with fibres and yarn it does only a part of a job which can never be as good as doing a whole job.

The book is practically free from misprints and conforms to the usual standards of elegance of the Committee's publications; '30s' should be short for '30 counts' and as such whether '30s counts' (page 51) is correct, requires clarification.

Srinagabhuhana.

AQUAMETRY *

THE importance of estimation of water cannot be over emphasised both in the laboratory and in industry. The influence of moisture on chemical kinetics has been a vast subject of intensive investigation and a quick and accurate method of determination of moisture in this field of research is of paramount importance. The determination of moisture in edible and in industrial products is in no way less important. The keeping quality and the behaviour towards milling of a large number of cereals are found to be dependent on their moisture content. The breakage of the grain would enormously increase on milling if the paddy were to contain more than 13% water. The moisture content of rice should always be less than 12% for its preservation. The water content of coffee, wheat and potato chips should always be less than 12%, 9% and 7% respectively in order to ensure freedom from attack by insects and pests. Moisture plays an important role in the preservation of fruits, egg and milk powders, beverages, confectionaries, starch, oils, fats and a host of other edible products. Narrow limits of moisture content are prescribed for a large number of explosives,

fuel and transformer oils, drugs and fertilizers to ensure the purity of the product and safety of preservation. The importance of a knowledge of water content in the evaluation of textiles can be visualised when it is seen that cotton and wool can take up moisture up to 25-30%. The instances mentioned above are but a few of a host of other commodities where quick and accurate method of determination of moisture is of utmost importance.

Oven drying is the oldest and perhaps the most widely employed method for the determination of moisture. Even today it is the simplest method for drying non-porous solids having no other volatile material. Recently several automatic moisture recorders have been put on the market where the humidity, gas circulation and the temperature of drying can be controlled with precision. The introduction of infrared radiation as a source of heating is the latest innovation in oven drying. With this improvement, the material to be dried is uniformly heated and the temperature of dehydration is lowered. In spite of these improvements the oven method is never satisfactory either for porous solids or for substances that undergo decomposition at the temperature of heating. It is needless to say that this method cannot be employed in the case of volatile liquids.

The distillation method is usually employed in industry where a large number of samples

* *Aquametry*. Application of the Karl Fischer Reagent to Quantitative Analysis involving Water. By John Mitchell (Jr.) and Donald Milton Smith, Interscience Publishers Inc. New York, 1948. Pp xi+444. Price \$ 8.00.

are to be analysed for their water content. The principle in general consists in distilling the material with an organic liquid immiscible with water and measuring the volume of water in the distillate. Azeotropes are some times claimed to be more convenient. This method is specially useful in the determination of moisture of semi-wet solids like organic fertilizers, clays, vegetables, fruits etc., and can be recommended as a quick and comparative method of determining the moisture.

The absorption method is a very general and accurate one for the determination of water in a variety of complicated systems including liquids and gases. In most of the cases an inert gas is passed over the material subjected to analysis and the moisture carried over is absorbed by a suitable desiccant. Even this method suffers from the temperature defect already pointed out and porous solids take long intervals for dehydration. Most of these defects can be overcome by use of vacuum for dehydration. The quartz spring method originally developed by McBain and his associates is perhaps one of the best methods of determining moisture in solids, both porous and non-porous. Since dehydration is carried out in vacuum, the rate of dehydration is high and comparatively low temperatures can be employed. An added advantage is that the amount of dehydration for any partial pressure can be accurately determined and hence ideally suited for studies on hysteresis in sorption.

Some of the physical properties have been employed in the determination of moisture but their use is very limited. Specific gravity, viscosity and refractive index are employed in the determination of moisture in a large number of binary mixtures where water is one of the components. The determination of refractive index can also be employed for the estimation of moisture in gases. The accuracy of their method depends upon the variation of the physical properties with the moisture content of the systems and also on the absence of other impurities that may interfere with measurement of these properties.

Critical solution temperature is also employed in the determination of moisture in liquids. This method is not only troublesome to employ as an analytical routine but also suffers from want of accuracy. Heat of dilution has been employed to estimate the moisture content of the acids while infrared spectrum is used to determine the water vapour in gases particularly in gaseous hydrocarbons.

By virtue of the simplicity of manipulation

the measurement of electrical conductivity, resistance or dielectric constant is coming into vogue in the routine analysis for water in some commercial products like wood, textiles, ceramics, paper, tobacco, cereals, petroleum oils etc. This method appears to be very simple but in practice it requires elaborate precautions and standardisations.

A wide variety of chemicals have been employed for the determination of water, the following being some of the reagents commonly employed to react with water, metallic sodium, calcium carbide, calcium hydride, magnesium nitride, sodamide, methyl magnesium iodide, sodium ethoxide. The gases that are produced during the reaction are estimated either volumetrically or by other analytical methods. But invariably the results obtained are mostly qualitative in nature since this involves a reaction between the solid phase and the liquid.

Smith and his collaborators developed in 1935, a new and accurate method for the determination of moisture taking advantage of the hydrolysis of acetyl chloride in presence of pyridine but soon found that substances like aldehydes, amines, lower alcohols etc., interfere in the analysis. At about the same time Karl Fischer announced that a solution of iodine, sulphur dioxide and pyridine in methyl alcohol could be employed for the estimation of water in a large number of systems. Smith and co-workers took up this piece of investigation and carried out very valuable work elucidating the chemistry of Karl Fischer reaction. Coming as it does from pioneers in this field of research work, the book "*Aquametry*" gives an authoritative account of the nature and mode of application of this important reagent.

The chief difficulty that presents itself in the use of Karl Fischer reagent both to the beginner and to the experienced analyst, happens to be the instability of the reagent even under the best of experimental conditions. Even a fresh reagent has only 80% of the theoretical potency. Realising this drawback the authors have spared no pains in describing in detail, the elaborate precautions that should be taken in the preparation and application of the reagent. Whatever may be the accuracy with which moisture in methyl alcohol can be estimated, the present method is bound to fail if the moisture is not quantitatively removed by the alcohol. In a good number of insoluble systems, the authors have given numerical data regarding the accuracy of the estimation of moisture as compared with the other standard

methods. The application of Karl Fischer reagent in the estimation of moisture in a large number of organic compounds has been described in great detail. In addition to the moisture determination, the use of the reagent to estimate organic functional groups like hydroxyl, amino, carbonyl, nitrile, etc., is dealt with exhaustively. The literature on the subject is collected upto the early months of 1947 and is quite comprehensive.

In their enthusiasm to stress the importance of the reagent the authors have not been quite critical on the efficiency of the reagent when applied to certain systems. The determination of water in silica gel can be quoted as an instance. The moisture content of the gel by the Fischer reagent is 5.48% as against a value of 4.7% determined by drying the sample at 150° C. for 4 hours. It is well known that silica gel retains 4-5% water even after prolonged drying at 150° C. Hence it has to be concluded that the present method gives low values for moisture in silica gel. Similar low values are also obtained in the case of calcium sulphate. It is thus obvious that the Karl Fischer reagent cannot be employed in the case of insoluble porous solids like silica gel or alumina where the solid surface has a great avidity for water. In

fact anhydrous alumina can be employed "to remove the last traces of water from alcohols!"

The term "Aquametry" has been coined by the authors to represent 'the analytical process of water measurement of materials'. The reader would then expect a detailed and critical account of the several methods that are at the disposal of the chemist for the analysis of water. But it is sad to find that the authors have devoted only 16 pages for the review of various methods in "Aquametry". Methods where physical properties like density, refractive index and viscosity are taken advantage of in the aquametry, find only a passing mention in this book. The reader would have been greatly benefitted if the authors had devoted about 100 pages where a critical account of the existing methods for aquametry had been given in addition to the present information about Karl Fischer reagent. The present volume can more appropriately be called by its secondary title: "Application of the Karl Fischer Reagent to quantitative Analysis involving water."

In conclusion the authors have to be congratulated for placing such a detailed and authoritative account of the Karl Fischer reagent at the hands of the analytical chemists.

M. R. A.

PEST INFESTATION RESEARCH*

THE first report of the work of the Pest Infestation Laboratory of the Department of Scientific and Industrial Research, England, has been published by the H.M.S.O. on June 7, 1949.

The laboratory was organised in response to a request from Industry for research on pest control, as related to pre-War conditions; but since the laboratory was actually constituted only after the outbreak of War, war-time problems of importance in pest control were given high priority. The most urgent of the problems, was the bulk storage of grain for long periods and in environments which proved propitious for insect development. While the Ministry of Food's Infestation Control Division did the work of inspection of stored food and the application of appropriate control methods, the Pest Infestation Laboratory's task was to undertake research to enable the Control Division to operate efficiently. This meant getting

to know all about the insects in relation to their food-stuff and the conditions under which it was stored. The work, therefore, involved biological studies of the insects and the mites and physical studies of the environment of the grain in bulk and in storage.

Three main lines of work that engaged the attention of the Pest Infestation Laboratory were— (1) Estimation of Infestation; (2) Development of control measures; and (3) Research on sprays. The estimation of the infestation of a given sample of grain was made possible by the improvisation of the "Carbon dioxide method", through which the "Carbon dioxide figure" for that sample could be worked out. Both the grain and insects infesting it produce together measurable quantities of carbon dioxide. Broadly the concentration of carbon dioxide found in the mass of grain stored is proportional to the number of insects present inside the grain. A related finding in this connection was that insects could and did cause grain to "heat" through the formation of "hot spots". Of the control methods developed, the fumigation of silo bins was the most important and is being used now on a very large scale. Re-

* Department of Scientific and Industrial Research, Rex-House, 4-12 Regent Street, London.

lating closely to fumigation of grain, were problems like the penetration of the gas into the food-stuff, its physical adsorption or chemical reaction and the nature and permanence of residual effects, in addition to the toxicity of the gas to the many insect species concerned. Sprays for the disinfection of warehouses in which insect-free food-stuffs had to be stored, were developed. In order to ensure a reasonably long toxic life of the insecticide film deposited on walls, boxes, etc., a method was developed for pretreating the surfaces to be sprayed, which gave a greatly increased duration of toxicity.

The Pest Infestation Laboratory also undertook work on fly-spays on behalf of the fighting services and was among the first to report on the striking toxicity of DDT to house-flies. A new spray-gun was also developed designed to withstand the toughest treatment and at the same time to provide an accuracy of performance not hitherto achieved.

In this context, the present conditions obtaining in India are of special interest. A somewhat parallel organisation to the Ministry of Food's Infestation Control Division in England, was set up in India practically after the cessation of the Second Great War, under the title—"Directorate Storage", whose duty was laid down to be the dissemination of knowledge in respect of useful methods of large-scale storage of locally-procured and imported grains of different kinds and the training of personnel for organising proper storage and promoting "go-down hygiene" and issuing of useful propaganda leaflets prescribing certain definite regulation to be followed. But no research laboratory of the kind of the Pest Infestation Laboratory in England, was set up, to undertake research to enable the control personnel to operate efficiently. Problems like the fumigation of

silo bins in England, are numerous in India and have long been waiting to be tackled with special reference to the peculiar and varying Indian conditions of storage of grains. Estimation of infestation of grain under Indian methods of storage and in a variety of receptacles used for storage, is vastly different from that applying to the silo bins. Equally different are the problems like the penetration of the gas, its sorption and the nature and permanence of residues, etc., in India. A host of other allied matters have been in need of investigation. A special well equipped central laboratory with competent staff alone could undertake research on these important and urgent problems.

The Indian Agricultural Research Institute at Delhi and the Agricultural laboratories in the several Provinces and States have never been properly and adequately staffed and financed for the purpose of conducting research on the varied problems; and the results already obtained by workers in these laboratories and by workers of special schemes financed by the Indian Council of Agricultural Research have not covered a wide enough field. One of the chief reasons for this state of affairs is the inherent defect in the organisation and working and lack of co-ordination. These could perhaps be remedied by organising a central Pest Infestation Research Laboratory, generously equipped and adequately staffed, and Bangalore would appear to offer an ideal place for locating the laboratory not only because of the substantial amount of pioneering work which has been carried out by the Entomological section of the Department of Agriculture but also on account of an active school of research on Insect Nutrition and Insect Physiology which has developed in the Division of Fermentation Technology at the Indian Institute of Science.

BEE COMPASS

Sunlight and the polarized light of the sky appear to enable a scout bee which has discovered a source of nectar to orient herself when executing a bee dance to tell other bees about her find. Distance is indicated by the dance pattern, direction by the way the bee's body is pointed most of the time, according to the Austrian entomologist, Professor Karl von Frisch. *Science Service* reports his announcement of this discovery at a recent meeting of scientists in Washington D. C.

In total darkness or red light (which bees

cannot perceive) the finder-bee became confused in her dance, but oriented herself toward the nectar find when a flashlight was held in the approximate position of the sun. When the flash-light "sun" was held in a false position, the bee gave an incorrect direction. The bee was also properly oriented when she could see a small patch of blue sky (polarized light) but became confused in the unpolarized light of a white cloud drifting across the opening. (By courtesy to *Sky and Telescope*, 1949, VIII, P. 253.)

SCIENCE NOTES AND NEWS

V-2 Solar Spectra

The ultraviolet spectra of the sun obtained during the V-2 flights of October 10, 1946 (*Sky and Telescope*, February 1947, p. 3), and March 7, 1947, have now been measured. In a report by E. Durand, J. J. Oberly, and R. Tousey, released by the Naval Research Laboratory, some 200 atomic lines between wave lengths 2200 and 3000 angstroms have been identified as arising from 10 elements, either in the neutral (I) or the singly ionized (II) state. These are iron I and II, chromium I and II, vanadium I and II, manganese II, magnesium I and II, calcium I, nickel I, titanium I, cobalt I and II, and silicon I. In these identifications the authors made extensive use of laboratory results and theoretical multiple tables by Dr. Charlotte Moore Sitterly, of the National Bureau of Standards.

Special attention is drawn to strong emissions of ionized magnesium at wave lengths 2803 and 2796 that had been predicted by Dr. Donald H. Menzel, of Harvard. In the previously observable spectra of the solar disk only the H and K lines of ionized calcium had shown emission, and they are weak in comparison with the newly observed ionized magnesium pair.

Noted incidentally was a strong band of nitric oxide at wave length 2264, presumably arising in our atmosphere. This spectrum had been obtained at an altitude of 55 kilometers. An average concentration of 0.01 per cent. of nitric oxide in the outer atmosphere would be detectable.

The complete report on the identification of the lines in the solar spectra obtained from V-2 flights will appear shortly in the *Astrophysical Journal* (By Courtesy to *Sky and Telescope*, 1949, Vol. VIII, P. 89.)

Central Institute Potato for Research

The Central Potato Research Institute set up a few months back by the Ministry of Agriculture, Government of India, started functioning at Patna, its permanent location, about a fortnight ago. The Institute which is believed to be the first of its kind in the East, will co-ordinate research so far undertaken in various sub-stations of the Indian Council of Agricultural Research at Simla, Bhowali and Kufri and will chalk out a scheme for fundamental research on the production and utilization of the potato crop.

For the present, the Institute has started

functioning in premises borrowed from the Government of Bihar who have placed a 25 acre plot and a few rooms, for laboratory and office purposes, at its disposal. Permanent buildings are not proposed to be built now in view of the need for economy in Government expenditure. When the financial situation eases, construction of permanent buildings will be taken up.

In India, although the soil is suitable in most areas for potato cultivation, only about 0.2 per cent of the total crop area is under potato and the annual production is about 1,800,000 tons. Leaving aside the quantity required for seed purposes, about 8 lbs. of potato are available annually per head as against about 500 lbs. per head per annum in some of the Western countries.

The main obstacles in the way of increased production of potato in India are: 1) absence of different varieties of potato suited to varying conditions of climate and soil in different parts of the country; 2) non-availability of sound, healthy seed in adequate quantities, at the right time and at a reasonable price and 3) the heavy toll taken by fungal, bacterial and virus diseases and insect pests. The Institute will undertake research into these problems.

Indian Medicinal Plants

A scientific enquiry, extending over a period of 12 years, on Indian medicinal plants and food poisons which was launched under the auspices of the Indian Council of Agricultural Research in 1935 has now been completed and Col. R. N. Chopra, at present Director, Drugs Research Laboratory, Srinagar, who conducted the enquiry, has submitted his final report to the Council.

Publications of a monograph on poisonous plants in India, establishment of a Herbarium of medicinal and poisonous plants, preparation of a list of Indian Pharmacopœ and encouragement to the cultivation of medicinal plants in the country are some of the tangible achievements arising out of the scheme. Besides, the results of the enquiry have also been of considerable assistance to the establishment of the Central Drug Research Laboratory at Lucknow.

The Report says that the enquiry has definitely advanced the knowledge with regard to pharmacopœial and allied drugs in India. A number of firms manufacturing drugs from Indian medicinal plants have come into existence and, instead of depending on concentrated

extracts from foreign countries, practically every type of galenical is now being manufactured in India from materials produced in the country.

India is the emporium of all kinds of medicinal herbs and drugs and, with suitable facilities, she can produce not only enough for her internal requirements but can also spare considerable quantities for export. The enquiry has stimulated cultivation of medicinal plants. Among drugs which have been brought into extensive cultivation may be mentioned belladonna, digitalis, hyoscyamus, colchicum, gentian, ephedra, pyrethrum, etc., etc.

Indian Central Cotton Committee

The Government of India have appointed the following as members of the Indian Central Cotton Committee, representing the various interests concerned:

Shri R. G. Saraiya (Co-operative Banking), Shri Madanmohan Mangaldas (Ahmedabad Millowners' Association), Shri G. M. Kothari, M. L. A. (Cotton Ginning or Manufacturing Industry in Madras), Shri A. K. D. Balarama Raja (Cotton Growing Industry in Madras), Shri Narayan Dass Mukerjee, Director of Food and Civil Supplies, Vindhya Pradesh, and Seth Bhogilal M. Shah (United State of Kathiawar).

The following have been appointed as Additional Members:—

Shri Neville Wadia, Pandit Thakar Dass Bhargava, Member, Constituent Assembly of India, Shri Bhawanji A. Khimji, President, Indian Merchants' Chamber, Bombay, and Shri T. P. Barat, Textile Commissioner to the Government of India.

Post-Graduate Research Grants for Indians

Two Indians are among the 32 Commonwealth university teachers and post-graduate research workers to whom travel grants under a new scheme have been awarded by the British Council for the purpose of study at British universities.

The Indian beneficiaries are Mr. O. P. Bhatnagar of Allahabad University, who is now studying history at the University of London, and Mr. B. Bhattacharya from Benares University who will shortly be reaching Cambridge to study spectroscopy.

The scheme, established as a result of the discussions at the first post-war Congress of Universities of the Commonwealth held last year at Oxford, is intended to facilitate the interchange of university teachers and scholars between the Commonwealth countries and the United Kingdom.

Facilities for Displaced Students

The University of Saugor and the Birla Education Trust, Pilani, have offered to take refugee students who may be unable to continue their college studies in Delhi for want of accommodation in local colleges. Students desirous of availing this opportunity may contact the Registrar, University of Saugor, Saugor C. P. or Principal, Birla College of Arts, Science and Commerce, Pilani, Jaipur Division, Rajasthan for terms and conditions of admission.

Mathematical Society

The Sixteenth Conference of the Indian Mathematical Society will be held in Madras under the auspices of the University of Madras on the 26th, 27th and 28th December, 1949.

Prof. M. H. Stone of Princeton, Dr. Tietjens of the Indian Institute of Science, Prof. Hermann Wold of Sweden are expected to attend the session. A Mathematical Exhibition will be held during the period.

The Geological, Mining & Metallurgical Society of India

The Geological, Mining and Metallurgical Society of India held its 25th Annual General Meeting on Friday, the 16th September 1949, in the Rotary Hall of the Great Eastern Hotel, Calcutta. Dr. M. S. Krishnan presided and Dr. D. N. Banerjee, the Vice-Chancellor of the Calcutta University, was the Chief Guest on this occasion.

Andhra University—Award of Research Degree in Chemistry

On the recommendation of the Board of Examiners consisting of:—

1. Dr. N. H. Burman (*Chairman*), Professor of Chemistry, Frick Chemical Laboratory, Princeton University, Princeton, New Jersey, U.S.A., 2. Dr. James J. Lingane, Harvard University Department of Chemistry, 12, Oxford Street, Cambridge 38, Massachusetts, U. S. A., 3. Professor G. Fredrick Smith, Associate Professor, University of Illinois, Illinois, U. S. A. appointed to adjudicate on the thesis entitled "Catalyzed and Induced Reactions in Analytical Chemistry". the Syndicate has resolved that Mr. J. V. S. Ramanjaneyulu, M. Sc., be declared qualified for the Degree of Doctor of Science (D.Sc.)

ERRATUM

Vol. XVIII, No. 7, July 1949, page 232

Article on "The Theory of the Christiansen Experiment"—In Column 2, the correct formula should read as follows:

$$I = I_0 \cdot e^{-\pi^2(\mu_1 - \mu_2)^2 \Delta z / \lambda^2}$$

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NOTICE

The last date for the receipt of applications for the post of Director, Central Drug Research Institute, Lucknow, has been extended upto 31st October 1949.

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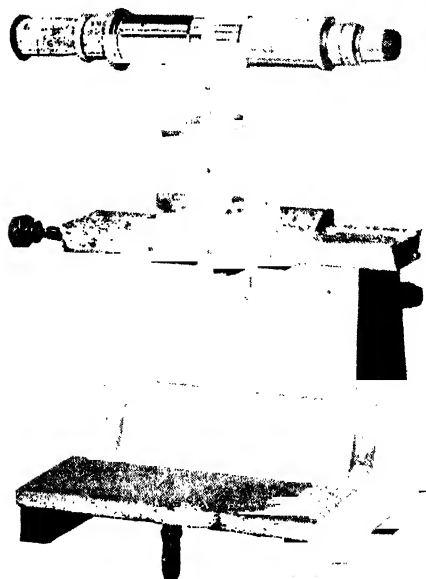
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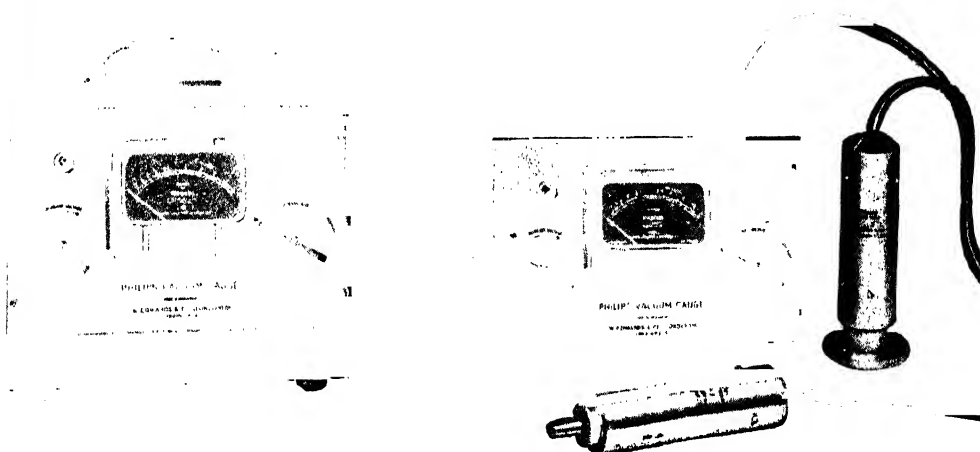
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Current Science

Vol. XVIII]

OCTOBER 1949

[No. 10

	PAGE		PAGE
<i>Maximization of Scientific Effort</i> ..	365	<i>Obituary—The Late Prof. M. S. Sabhesan</i>	370
<i>The Indian Science Congress, Poona</i> ..	366	<i>Regional Scientific Bibliography for S. E.</i>	
<i>Acetylation in the Laboratory Diagnosis of "Burning Feet Syndrome" (Pantothenic Acid Deficiency)—P. S. SARMA.</i>		Asia	370
P. S. MENON AND P. S. VENKATACHALAM	367	<i>Letters to the Editor</i>	371
<i>The Life-History of a Typical Funnel Cloud—Dr. M. W. CHIPLONKAR</i> ..	368	<i>Reviews</i>	384
		<i>Science Notes and News</i>	392

MAXIMIZATION OF SCIENTIFIC EFFORT

IN the course of his memorable address to the Staff and Students of the Indian Institute of Science, early this year, Prime Minister Nehru told his audience that the quality and output of scientific work in India were commensurate neither with the amount of funds allotted for research nor with the potential scientific talent which the country could mobilise. This unhappy circumstance is due largely to the lack of a congenial "research climate" which would stimulate and inspire scientific effort. The "Research climate" can be created; it is the spontaneous result of dynamic and inspiring leadership and enlightened administration free from pettiness and red tape.

Magnificent and stately buildings, lavishly equipped laboratories, the latest and the most modern tools of research, and an abundance of grants, by themselves, cannot bring about the research climate; it is the men that count in this respect. At the moment, we have very few men in the country who can

be trusted to achieve this difficult but indispensable task of creating a proper atmosphere for nurturing scientific talent and promoting research. Some of our foremost institutions and universities are suffering for want of such men. The adoption of a policy of the short-sighted and bigotted parochialism in recruiting men of science for responsible positions, has led to disastrous results in the case of some of the research institutions in the country. If we are to make any worthwhile contributions to world's science and technology we should not hesitate to draw freely from the world's pool of scientific and administrative talent with a view to make up our deficiencies. Other countries have adopted such a policy in the past. We are gratified to learn from the latest despatches appearing in the press that, the Government of India, acting on the advice of Pandit Nehru, have already moved to take the necessary steps in this direction.

THE INDIAN SCIENCE CONGRESS, POONA

THE Indian Science Congress is scheduled to hold its 37th session at Poona from 2nd to 8th January, 1950. The President is Sir K. S. Krishnan and the President-elect is Prof. P. C. Mahalanobis. Honourable Dr. Shyamaprasad Mukherjee, Minister for Industries and Supplies, Government of India, will inaugurate the session and His Excellency Sir Maharaj Singh, Governor of Bombay, has been approached to become the Patron for the session. The Vice-Chancellor of the Poona University has extended an invitation to all scientists interested in the development of science to assemble at Poona and help in making the deliberations of the session a success.

The work of the Indian Science Congress session will be organised into 13 different sections, each presided over by a Sectional President. The following are the Sectional Presidents: Dr. N. M. Basu (Aligarh), Mathematics; Dr. P. V. Sukhatme (New Delhi), Statistics; Dr. R. N. Ghosh (Allahabad), Physics; Dr. J. K. Chowdhury (Calcutta), Chemistry; Mr. J. Coates (New Delhi), Geology and Geography; Dr. P. Maheshwari (Delhi), Botany; Dr. B. C. Basu, (Izatnagar), Zoology and Entomology, Dr. Von Fuhrer Haimendorf (Hyderabad), Anthropology and Archaeology; Dr. M. V. Radhakrishna Rao (Bombay), Medical and Veterinary Sciences; Mr. R. L. Sethi (New Delhi), Agricultural Sciences; Dr. Kalidas Mitra (New Delhi), Physiology; Prof. Kali Prasad (Lucknow), Psychology & Educational Sciences; Dr. D. R. Malhotra (Ajmir), Engineering and Metallurgy. Meetings of each section will be normally held every day, where original papers will be read. Discussions on subjects of special scientific interest have also been arranged both in individual sections as well as jointly in more than one section.

FOREIGN SCIENTISTS

As on previous sessions of the Congress at Delhi, Patna and Allahabad, a special feature of the Poona Congress will be the visit of a delegation of front-ranking overseas scientists from Great Britain, America and France. Invitations have already been extended to these delegates by the Indian

Science Congress Association and also by the Department of Scientific Research, Government of India, through the various Indian Embassies in foreign countries. It is expected that the team from Great Britain would consist of Sir Robert Robinson, President of the Royal Society, London, Prof. J. H. Burn, Britain's top-ranking Pharmacologist in the Oxford University, and Prof. Desmond Bernal, the distinguished Physicist. From America Prof. Herman Mark, the internationally known expert on high polymers, originally of Germany and Prof. Szent Gyorgyi, the celebrated Biochemist, originally of Hungary, have been invited. France is sending Professor and Madame Curie-Joliot, known all over the world for their contributions to Atomic Physics. Invitations have also been sent to many learned societies and bodies in Afganistan, Ceylon, Australia, Canada, etc., to send their delegates to the session, if possible. It is hoped that the overseas scientists would be staying here for a period of about two months and would deliver lectures and give demonstrations in the various academic centres throughout India.

POPULAR LECTURES

A special feature of the Congress would be the organisation of a series of 'popular lectures' on scientific subjects, which will be arranged in the evening. The subjects of the lectures are chosen in such a manner that the best scientific brains of India and foreign countries can place before the public in a popular way the implications of science in social welfare and the achievements of sciences towards nation-building activities. Arrangements are being made to have some of these lectures broadcast and the Association will later publish them for distribution to learned societies, bodies and institutions, etc.

Universities and other academic centres desirous of arranging lectures and discussions by foreign scientists in their institutions are requested to get into touch with the General Secretaries (Dr. B. Mukerji, 1, Park Street, Calcutta, and Prof. B. Sanjiva Rao, Indian Institute of Science, Bangalore).

ACETYLATION IN THE LABORATORY DIAGNOSIS OF "BURNING FEET SYNDROME" (PANTOTHENIC ACID DEFICIENCY)

P. S. SARMA,* P. S. MENON AND P. S. VENKATACHALAM

(Nutrition Research Laboratories, Indian Research Fund Association, Coonoor, South India)

LIPMANN and his co-workers have shown that coenzyme A, which is concerned with the *in vitro* acetylations of sulfanilamide and choline contains large amounts of pantothenic acid.^{1, 2, 3} Riggs and Hegsted⁴ found subsequently that acetylation in rats depended on an adequate intake of pantothenic acid. Normal rats acetylated 70% of the amount excreted in 24 hours after a 1 mgm. or 2.5 mgm. dose of para-amino benzoic acid (PAB) given intraperitoneally. On the other hand, rats which were pantothenic acid deficient, acetylated only 50% of a 1 mgm. dose and 37% of a 2.5 mgm. dose of PAB. Simultaneous injections of one mgm. of calcium pantothenate to the deficient animals caused a return of their acetylation values to normal.

The 'burning feet syndrome' in humans has been investigated by Gopalan.⁵ He has attributed the syndrome to the deficiency of pantothenic acid and has obtained remarkable improvement by the administration of calcium pantothenate. Glusman has also described this syndrome of burning feet as a manifestation of nutritional deficiency.⁶ The present investigation deals with acetylation of PAB in humans both normal and those suffering from 'burning feet syndrome'.

The diagnosis of 'burning feet syndrome' is based on the description of the symptoms given by the patients. All the patients examined, complained of a burning sensation of the soles of the feet, which was comparable to that of keeping the feet on red hot coal. The burning sensation increased after walking and also after covering the feet with a blanket. Some cases complained of tingling and numbness of the toes. Dryness of the skin, angular stomatitis, cheilosis and fissured tongue were also frequently found in association with burning feet. The tendon reflexes were brisk; there were no sensory changes or muscular wasting. Treatment with riboflavin did not give any relief as far as burning feet was concerned, though manifestations of riboflavin deficiency dis-

appeared. Thiamin and nicotinic acid were ineffective. With intramuscular injections of 50 mgm. of pantothenol daily,⁷ mild cases of 'burning feet syndrome' obtained relief after a week's therapy, whereas in more severe cases, complete cure was obtained after similar treatment for a period of two to three weeks.

Acetylation was determined by the administration of either 100 mgm. or 200 mgm. of PAB to patients, collecting their 24 hours' urine immediately thereafter, and determining the free and total content of PAB in the urine by the method of Bratton and Marshall.⁸ The results are presented in Table I along with the acetylation values obtained after treatment with either riboflavin or pantothenol. Eleven normal persons had an acetylation value of 91.5% when 100 mgm. PAB was given, while eight had 91% when 200 mgm. PAB was administered orally. Intramuscular injections of either riboflavin or pantothenol did not change the acetylation values, when determined on some of these normal persons. However, in patients, who were suffering from 'burning feet syndrome', the acetylation value was found to have decreased to 84.9%, when 100 mgm. PAB was given and to 78.9% when 200 mgm. PAB was the dosage employed. Treatment with riboflavin, thiamin or niacin did not raise the acetylation value, whereas administration of pantothenol brought it to very nearly the normal figure with a simultaneous relief of the subjective symptoms of burning feet. These results show for the first time, the biochemical function of pantothenic acid in humans as significantly affecting acetylation processes in the body.

As objective signs in the diagnosis of 'burning feet syndrome' were lacking, acetylation values served as a useful aid in the routine examination of this syndrome. However, a few cases have been met with, who complained of burning feet, but who had normal acetylation values and who did not improve after treatment with pantothenol. It is possible that other factors may be involved in these cases. But, by and large, acetylation values determined with a dosage

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of 200 mgm. of PAB should prove invaluable in detecting genuine cases of pantothenic

TABLE I

Percent acetylation of PAB in normal and deficient persons

Dosage of PAB	Treatment		Normal subjects		Patients with burning feet	
	Ribofla- vin	Phanto- thenol	No.	Acetyla- tion value	No.	Acetyla- tion value
mgm.	mgm.	mgm.				
100	..	..	11	89.5-93.8 (Ave. 91.5)	3	84.6-85.6 (Ave. 84.9)
200	..	..	8	89.7-92.4 (Ave. 91.0)	4	77.7-79.9 (Ave. 78.5)
100	125	..	1	92	1	84.2
100	..	350	1	90.7	1	87.6
200	..	350-750	2	91.6	6	86.9-90.3 (Ave. 88.8)

acid deficiency among the various patients complaining of 'burning feet'. Acetylation would thus serve as a useful laboratory diagnosis in detecting cases of 'burning feet syndrome'. Treatment with sulfa drugs or an attack of malaria during the acetylation

determinations have been found to vitiate the results and hence care must be taken to exclude these conditions during the test. Other conditions likely to interfere with acetylation in the laboratory diagnosis of this nutritional deficiency are under investigation and full details will be published later in the *Indian Journal of Medical Research*.

Our thanks are due to Dr. V. N. Patwardhan, Director, Nutrition Research Laboratories, for his kind encouragement and to Hoffman-La-Roche, Basle, Switzerland, for the gift of 'Bepanthen' (Pantothenol).

1. Lipmann, F., Kaplan, Nathan, O., David G., Tuttle Constance, L. and Guirard Beverly, M., *Jour. Biol. Chem.*, 1947, **167**, 869. 2. Lipmann, F., Kaplan Nathan, O., *ibid.*, 1946, **162**, 743. 3. —, *Federation Proc.*, 1946, **5**, 145. 4. Riggs Thomas, R. and Hegsted Mark, D., *J. Biol. Chem.*, 1948, **172**, 544. 5. Gopalan, C., *Ind. Med. Gaz.*, 1946, **81**, 23. 6. Glusman, M., *Amer. J. Med.*, 1947, **2**, 211. 7. Rubin, S. H., Cooperman, J. M., Moore, M. D., and Scheiner, J., *Nutrition*, 1948, **35**, 499. 8. Bratton, A. C. and Marshall, E. K. Jr., *J. Biol. Chem.*, 1939, **128**, 537.

THE LIFE-HISTORY OF A TYPICAL FUNNEL CLOUD

DR. M. W. CHIPLONKAR, M.Sc., D.Sc.

TORNADOES, Waterspouts and Funnel Clouds (Elephant's Trunks) indicative of violent whirling motion in the atmosphere, are quite frequent in some parts of North America. The frequency, for instance, of destructive tornadoes is as high as a dozen per year in Kansas State in the U.S.A.^{1,2,6,7} Other principal tornado regions of the world are North Africa, Southern and Western Europe, China, parts of Central Asia and Australia. In India (and in the Tropics in general)⁶ it is a rare phenomenon, only few instances being on record.³ The tornado that occurred on the 5th April 1933 at Peshawar,⁸ the group of three waterspouts that were observed over the North Bay of Bengal² on the 14th February 1936 and the tornado cloud recently observed at Madras⁵ on the 8th October 1945 are, perhaps, the only examples that have been well recorded.

It is the purpose of this note to put on record one more typical instance of a Funnel Cloud that was observed by the author on the 26th June 1946 at Dum Dum (about 10 miles NE of Calcutta).

In the afternoon of 26th June 1946 the sky at Dum Dum was overcast (8-9/10ths sky covered with Cu, Fb, and Ns) and slight intermittent rain was falling; when suddenly at about 1510 hours I.S.T. the author noticed a protuberance of a very unusual form at the base of a cloud in the SW portion of the sky. It soon developed into a tube-like appendage obliquely hanging from the base of the cloud (see Plate I, Fig. 1). Even at this stage it showed a whirling motion about its axis which obviously indicated the cause of its formation. Further development then continued rapidly and simultaneously in two directions:—

(i). More and more cloud material was formed or drawn into the whirl to produce longer and longer trunk below the cloud base;

(ii) The growing trunk itself travelled bodily in a curved path.

pictures in pencil which are reproduced in Plate I, Figs. 1-6. They thus represent six successive stages (not at equal intervals of time) in the development of the phenomenon which only lasted for about 15-16 minutes. The trunk had a slate colour and

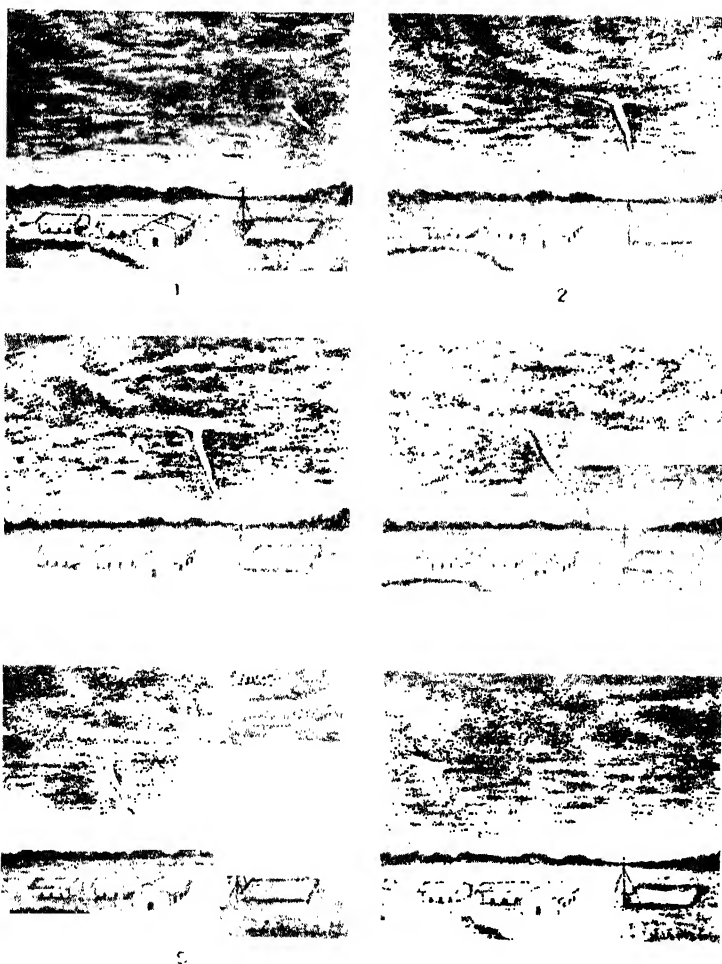


PLATE I. The Life-history of the Funnel Cloud observed on the 26th June 1946 at Dum Dum

The author had no camera to obtain a photographic record of this unusual phenomenon; and so made quickly on the spot a number of sketches in pencil as it progressed. In addition to this, careful notes were made at intervals about the phenomenon itself as also about other relevant atmospheric conditions at the place of observation. The pencil sketches were later on used to draw at leisure the six

as shown in these pictures had a very smooth and round appearance throughout. At first, it came down rather slowly up to the fourth stage (1520 hours I.S.T.) but afterwards got lifted up, shortened and vanished suddenly in the clouds above (1525 hours I.S.T.). At this time the cloud base was approximately 1.5 km. above the ground and about 9/10ths of the sky was covered with Cu, Fb and Ns. The surface wind

was light and variable, SW/S. From the observed churning movement of the cloud mass from which the trunk was hanging and also from the lively wriggling movement of the lower portion of the trunk it could easily be inferred that the whirling motion was very vigorous in the first four stages and in the fifth and the sixth stages it had slowed down considerably. The trunk, to start with, as shown by its position in Fig. 1, was nearly to the South-West and then gradually moved from there with an easterly component. It did not, however, travel in a straight line but approached the observer in the first four stages and receded from him during the later stages. When it was nearest to him about 2.5--3 miles away (Fig. 4), the lower end of the trunk was not well defined but could well be estimated to have come down to within a distance of 500--600 ft. of the ground. Of course, it never touched the ground, nor did it visibly influence any objects on the ground. As in most tornadoes, it may be noted that here also the

whirling process (presumably counter-clockwise as seen from above) appears to have started high up in the atmosphere, at or above the cloud level, and gradually descended downwards as it strengthened.^{3,8,9} A more detailed and quantitative discussion of this phenomenon, however, could not be taken up here as, particularly, the upper air data of (26-6-1946) for Dum Dum (or neighbourhood) are not available.

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1. Brooks, C. F., *Why the Weather?*, 1935, p. 138, New York.
 2. Conolly, F. C., *Report on the Administration of the India Meteorological Department* (1936-37), Frontispiece.
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OBITUARY

THE LATE PROF. M. S. SABHESAN

THE sudden death of Professor M. S. Sabhesan who, for 30 years, was in charge of the Botany Department in the Madras Christian College, is a great loss not only to that Institution but also to the whole educational world of South India.

The late Professor was no narrow specialist. His sympathies were as wide as his abilities and extended beyond text-books and curricula into the living world of men of the profession.

He was a progressive scientist and educationalist being one of the enthusiastic supporters of the South Indian Science Association founded in 1919. In espousing the cause of teachers he believed he was serving the cause of teaching and higher learning. He genuinely dedicated his spirit to the profession which he zealously followed, and has earned his blissful rest in communion with his Maker.

P. R.

Regional Scientific Bibliography for S.E. ASIA

THE UNESCO Office in South Asia proposes to compile a regional scientific bibliography to be distributed among the outside scientific world so as to increase the exchange of scientific literature from this region.

The bibliography is to be published annually with only the titles, authors' names and references to scientific publications in all branches of pure and applied sciences, including also the social, historical, and educational aspects of

science. Emphasis will be on original papers, books, monographs, reviews, surveys, annual reports, etc. All scientific organisations and individual scientists of this region, are invited to send such reprints, reports, etc., as are not readily available in public libraries, or at least to indicate their titles and references. A small fund is available for subscription and purchase of these publications. Postage will be refunded.

LETTERS TO THE EDITOR

	PAGE		PAGE
The Band Spectrum of Tantalum Oxide— I. FERNANDO AND S. G. KRISHNAMURTY	371	The Cation Exchange Capacity of the Different Mechanical Fractions of the Soil and its Organic Matter—A. N. PATHAK, S. K. MUKERJI AND J. C. SHRIKHANDE	375
Ultrasonic Velocities in Mineral Acids— J. BHIMASENACHAR AND T. SESHAGIRI RAO	372	A Note on the Chromosome Numbers of Some Economic Plants of India— N. KRISHNASWAMY AND V. S. RAMAN	376
Elastic Constants of Corundum— J. BHIMASENACHAR	372	Some Observations on an Obscure Disease of Paddy: <i>Oryza sativa</i> —A. B. SARAN	378
Effect of Alkali Chlorides on the Intensity of the Cyanogen Bands in Carbon Arc— P. S. MENE AND D. J. DESHMUKH	373	Seed Setting in Kudzu Vine, <i>Pueraria thunbergiana</i> —P. M. DABADGHAO	379
A New Reaction for the Synthesis of Chromones and Isoflavones—V. R. SATHE AND K. VENKATARAMAN	373	An Oil-Bearing Alga from the Palana Lignite (? Eocene) of Rajputana— S. R. NARAYANA RAO AND S. S. MISRA	380
Effect of Penicillin on the Bacterial Con- taminants of Vaccine Lymph (Calf Lymph)—V. N. KRISHNAMURTHY	372	Coumarins as New Indicators in Acidi- metry and Alkalimetry—N. M. SHAH AND L. D. DAVE	381
Synthesis of Yohimbine and Related Ring Structures—K. K. MATHEW AND K. N. MENON	374	Vanadimetry—Part IV. Volumetric Esti- mation of Hydroquinone by Sodium Vanadate—G. GOPALA RAO, V. BRAHMAJI RAO AND M. NARASIMHA SASTRI	381
Note "On a Certain Distribution in the Theory of Sampling"—V. S. ANANTHA- CHAR	374	Nature of Activated Sludge and its Bear- ing on De-Watering the Material— S. C. PILLAI	382

THE BAND SPECTRUM OF
TANTALUM OXIDE

THE spectrum of tantalum oxide was photographed in the visible region by using a Littrow model spectrograph. The sources of the spectrum were high current arcs between (1) tantalum rods, (2) carbon rods stuffed with tantalum oxide, in air; and arcs between tantalum rods in oxygen. A band system extending from λ 5500 to λ 3900 was obtained. Though the heads are not very prominent, it was possible to arrange more than twenty of these bands into a Deslandre's scheme.

The system corresponds to the α -system of zirconium bands investigated by Frances Lowater. Table I presents a few of the bands at the relevant corner of the Deslandre's table.

TABLE I

$\begin{matrix} \lambda'' \\ \lambda' \end{matrix}$	0	1	2
0	22639.9	21490.0	20362.3
1	23348.7	22198.8	21071.1
2	24064.9	22920.0	21776.0

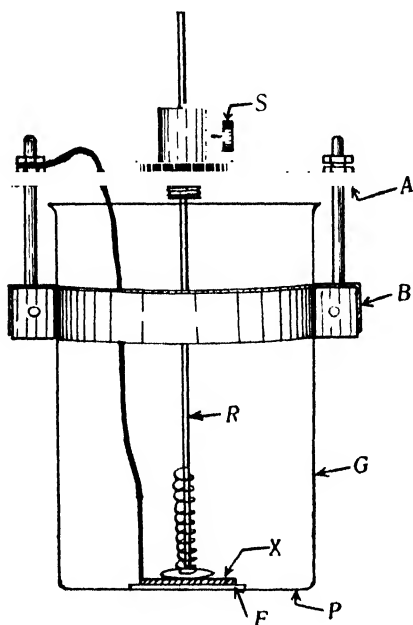
The values of W_e' (712.7), W_e'' (1161.6), $X_e'W_e'$ (1.95), $X_e''W_e''$ (5.85) compare favourably with the corresponding values for TiO, VO, CrO, MnO, ZrO, etc., molecules.

Physics Department, I. FERNANDO.
Presidency College, S. G. KRISHNAMURTY.
Madras,
September 2, 1949.

ULTRASONIC VELOCITIES IN MINERAL ACIDS

THE determination of ultrasonic velocities in mineral acids has been made difficult by the fact that the mineral acids attack the material of the crystal holder and the silvering on the piezo-crystal.

These difficulties are overcome by using a specially designed crystal holder which



consists of a pyrex glass tube G whose bottom end is closed by a flat glass plate P fused on to it. The tube is held rigidly by means of the brass clamp B attached to the ebonite insulating head A. The silvered piezo-crystal X is laid inside the tube and lightly pressed on to the plate P by means of the spring loaded rod R whose position can be fixed by the set screw S. The rod R serves as one lead for the electrical circuit and the second lead is furnished by a thin tin foil F pressed between the bottom of the crystal and the glass plate P. A drop of transformer oil between the tin foil and the glass plate provides a good acoustical path for the vibrations of the crystal to pass through the plate P. The entire assembly is held in a retort stand, provided with sufficient levelling facilities, and lowered till the glass plate P just touches the surface of the acid under investigation.

Using this crystal holder the ultrasonic velocities in hydrochloric acid, sulphuric acid and nitric acid are determined at a frequency of about 2.75 Mcs., by the Debye-Sears diffraction method. The acids used in the present investigations are ordinary bench reagents and their concentration is about 90%. The values of the ultrasonic velocities in the three acids are given below:

Ultrasonic velocities in mineral acids

Acid	Temp.	Velocity (m./s.)
Hydrochloric acid	.. 25° C.	1554
Sulphuric acid	.. ..	1429
Nitric acid	.. ..	1354

Further work with pure analytical reagents is in progress and will be published elsewhere.

Dept. of Physics, J. BHIMASENACHAR.
Andhra University, T. SESHAGIRI RAO.
Waltair,
September 5, 1949.

ELASTIC CONSTANTS OF CORUNDUM

MEASUREMENTS of the elastic constants of synthetic alumina recently reported by Sundara Rao¹ were made on crystal sections of odd orientations, the constants being obtained by the sum and difference methods. Here, the elastic constants of a single crystal of naturally occurring corundum are submitted for comparison.

The author's specimen was brownish and opaque, about 1" in diameter and 1.5" long, and had well-developed basal plane and prism faces. Suitable sections were cut from it to determine the six constants uniquely. These values with those of Sundara Rao are given below:

Elastic Constants of Corundum

	c_{11}	c_{33}	c_{44}	c_{12}	c_{13}	c_{14}
Author	.. 46.5	56.3	23.3	12.4	11.7	10.1
Sundara Rao	.. 46.6	50.6	23.5	12.7	11.7	9.4

It can be seen from the table that excepting for a small difference in c_{33} , the agreement is very good.

The full details are available in the author's report to the National Institute of Sciences of India.

J. BHIMASENACHAR.

Dept. of Physics,
Andhra University, Waltair,
September 9, 1949.

1. Sundara Rao, *Proc. Ind. Acad. Sci.*, 1949, 29, 352.

EFFECT OF ALKALI CHLORIDES ON THE INTENSITY OF THE CYANOGEN BANDS IN CARBON ARC

INTRODUCTION

THE Ga line 4172 Å lies within the region of one of the systems of the CN bands which extends from 4153 Å to 4216 Å. The region is blackened by these bands and hence makes the detection of the Ga lines difficult. An attempt has been made to diminish the intensity of these CN bands by the addition of alkali halides to the arc.

EXPERIMENTAL

A procedure differing from that of Ashton¹ was followed. Carbon electrodes were coated with alkali chlorides by dipping them vertically in saturated solutions and evaporating to dryness. Solid adherents if any were removed by washing. The electrodes were arced for 60 seconds at 6 amperes using 220 volt D.C., through watercooled control. The arc was kept fixed at 4 mm. Pure carbon electrodes were also arced under identical conditions, and all photographs were taken with a grating spectrograph.

Band intensity measurement in the negative was carried out by a photocell and a microammeter. Due to rotational structure of the bands the intensity was averaged over a small range. Measurement of intensity gave an estimate on an arbitrary scale. The results indicate that the suppression is most effective in the case of Cs and least for Li.

Laxminarayan Institute of Technology,
Nagpur,
September 9, 1949.

P. S. MENE.
D. J. DESHMUKH.

1. Ashton, *Jour. Soc. Chem. Industry*, 1949, 5, 185.

A NEW REACTION FOR THE SYNTHESIS OF CHROMONES AND ISOFLAVONES

THE interaction of *o*-hydroxyphenyl benzyl ketones with ethyl orthoformate in boiling pyridine containing a little piperidine gives isoflavones. Thus α -naphthaisoflavone is obtained from 2-phenylacetyl-1-naphthol, and 7-hydroxyisoflavone from 2:4-dihydroxyphenyl benzyl ketone in excellent yields. The ethyl orthoformate condensation can also be effected in acetic anhydride and zinc chloride, but under the conditions so far examined, the yields are poor. With 2:4:6-trihydroxyphenyl benzyl ketone, ethyl orthoformate gives deeply coloured, complex condensation products. With 2-acetyl-1-naphthol, the naphthachromone is obtained, together with a bright yellow by-product, m.p. 160°. The constitution of this compound and the mechanism of the reaction are being studied.

V. R. SATHE.

Dept. of Chemical Technology,
The University, Bombay,
October 13, 1949.

EFFECT OF PENICILLIN ON THE BACTERIAL CONTAMINANTS OF VACCINE LYMPH (CALF LYMPH)

HEAVY bacterial contamination in vaccine lymph (calf lymph) is inevitable during the process of its manufacture. None of the methods in use to bring about the reduction of its bacterial flora is satisfactory. Penicillin has recently been tried for the purpose, with spectacularly encouraging results. Our experience however in this direction has been disappointing. The use of such penicillin-treated lymphs is risky as penicillin not only does not bring about any bacterial reduction, but, what is more, gives extremely deceptive results. Most workers seem to have based their results without taking into consideration the interference of penicillin in the tests.

In one of the author's experiments on penicillin-treated lymphs, there was no growth on agar plates before removal of penicillin but after its complete removal they gave numerous organisms; the organisms are not killed but only inhibited by penicillin. Bactericidal action of penicillin is known to be maximum during the growth

phase of an organism in a nutrient medium while it is little or negligible on 'resting' organisms in non-nutrient fluids. In the vaccine lymph the organisms are in 'resting' phase in a non-nutrient medium and it is not strange that penicillin does not bring about any bacterial reduction in vaccine lymph.

V. N. KRISHNAMURTHY.

Vaccine Institute,
Bangalore City,
September 1, 1949.

SYNTHESIS OF YOHIMBINE AND RELATED RING STRUCTURES

THE recent publication by Swan¹ reporting the unsuccessful attempt to ring close 3-(2'-O-Hydroxymethyl-phenylacetamido-ethyl)-indole by heating under reflux for an hour, in an indifferent atmosphere, with phosphoryl chloride makes it necessary for us to publish this note. For some time past, one of us (Dr. K. N. Menon) has been carrying out a number of experiments to synthesise various members of the iso-quinoline and indole groups employing oxygen-alkyl substituted iso-chroman-3-one as the condensing unit. The successful development of the method has much interest in the direction of biogenesis of plant alkaloids according to Sir Robert Robinson's² classical theory. A large number of β -phenyl-ethylamines and iso-chroman-3-ones have been condensed and ring closed. The very heavy teaching duties of Dr. Menon has prevented more rapid progress and it is hoped grace time will be allowed to enable this laboratory to complete this work. In connection with this general scheme, synthesis in the Yohimbine group was taken up and as we had accumulated 3:4-methylene-dioxy-iso-chroman-3 one, we condensed this with tryptamine. The resulting amide gave no concrete result on treatment with phosphoryl chloride or phosphorous trichloride using benzene and its homologues as the solvent. Resinification under the action of hydrogen chloride seems to be the difficulty in this method. Using phosphorous pentoxide has given us positive results and we propose to submit the product obtained to very rigid examination before communicating the full account of this work.

The work of Jost,³ of Karrer and Enslin⁴ on corynanthein and Woodward and Mc-

Lamore's⁵ on the synthesis of sempervirine metho-salts by an elegantly unambiguous route, makes progress on the synthetical work we have undertaken of great interest.

Maharaja's College, K. K. MATHEW.
Ernakulam, K. N. MENON.
October 15, 1949.

1. J. C. S., 1949, 1720. 2. *Ibid.*, 1917, 111, 876; 1931, 3163; 1932, 789; 1933, 280; 1936, 1079.
3. *Helv. Chem. Acta.*, 1949, 32, 1297. 4. *Ibid.*, 1949, 32, 1390. 5. J. A. C. S., 1949, 71, 379.

NOTE "ON A CERTAIN DISTRIBUTION IN THE THEORY OF SAMPLING"

It is claimed that the distribution function of the variate

$$\xi = \frac{a_1 m_1 + a_2 m_2 + \dots + a_i m_i}{\sqrt{\{n_1 s_1^2 + \dots + n_i s_i^2\}}}$$

has been derived¹ without any restrictions on the constants a_i and that Simpson's theorem² is deducible from it as a special case.

Here, i = number of the samples drawn
 n_i = size of i th sample
 m_i = mean of i th sample
 s_i^2 = variance of i th sample
 a_i = constants.

The results and the proof given by the author are not new. Kempthorne³ has pointed out that even Simpson's theorem is not new though the proof is interesting. Distributions of $\Sigma a_i m_i$, $\sqrt{\Sigma n_i s_i^2}$ and their ratio are available in some of the text-books on Advanced Statistics.^{4,5}

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THE CATION EXCHANGE CAPACITY OF THE DIFFERENT MECHANICAL FRACTIONS OF THE SOIL AND ITS ORGANIC MATTER

As early as 1920 Ogg and Hendrick⁴ showed that the fine silt and silt fractions of some Scottish soils had an appreciable capacity for cation absorption. Russell⁷ on the other hand, stated that such properties of soil are connected more closely with the size of the soil particles than with their chemical composition. According to him the larger particles are so resistant as to be almost unchangeable and these chemical properties, apart from their inertness, are of minor importance compared with their physical properties. Russell's view has now been considerably modified by the recent investigations of Williams,⁹ Prescott and Hosking,⁶ Hosking and Piper⁵ and Burvill,³ Hosking.² These workers have adduced sufficient evidence to show that base exchange is not entirely a physical phenomenon but that it also depends upon the clay minerals which are also present in the coarser fractions of the soil, viz., silt and fine sand. Carroll¹ examined the fine sand fractions of several of the Australian soils and recorded the presence of clay minerals in all, in some instance quite considerable amounts. The results obtained in this laboratory on a different type of soil, viz., alluvial are also similar to those of the Australian workers and hence are recorded in this brief communication.

Soils from some profiles of our permanent wheat experimental plots were studied in this investigation. Results of analysis of two typical profiles are discussed here. Profiles were dug from the plot which received no manure since 1913 and others from the plot receiving annual dressings of farmyard manure. The various mechanical fractions were isolated after following the international method. Base exchange capacity was determined by Schollenberger's⁸

TABLE I
Mechanical composition of the soil

Depth	Manured			Unmanured		
	0-6"	6"-1'	1'-2'	0-6"	6"-1'	1'-2'
Clay ..	13.35	21.45	29.33	13.84	20.17	26.63
Silt ..	20.10	21.90	21.22	21.54	22.50	22.88
Sand ..	66.00	55.60	47.90	63.74	56.15	48.75

method. Mechanical composition of the soil is recorded in Table I and the base exchange capacity in Table II.

TABLE II
Base exchange capacity of the various
fractions in m.e. per cent. of the
primary particles

Depth	Manured			Un-manured		
	0-6"	6"-1'	1'-2'	0-6"	6"-1'	1'-2'
Clay ..	33.42	26.90	31.00	28.30	30.31	31.99
Silt ..	6.80	7.10	8.70	7.70	7.50	7.40
Sand ..	1.75	2.15	2.25	1.10	1.70	1.60

The data in Table II indicate that the base exchange capacity is not restricted to the colloidal or the clay fractions. There is, of course, a sharp decline in the exchange capacities from clay to sand fractions but the amount of base these fractions can hold is appreciable and persists at almost the same level into all the layers of both the plots.

The actual base exchange capacity of the soil devoid of organic matter may be calculated from the mechanical composition in Table I and the corresponding base exchange capacities in Table II. These calculated values along with base exchange capacity of the soil and soil treated with H_2O_2 is shown in Table III.

TABLE III
Calculated base exchange capacity of the
soil and different fractions free of
organic matter

Depth	Manured			Unmanured		
	0-6"	6"-1'	1'-2'	0-6"	6"-1'	1'-2'
A. Untreated soil	7.40	9.60	13.50	7.00	9.20	11.50
B. From soil after oxidation of O.M. with H_2O_2	5.30	7.00	11.49	5.80	7.01	9.99
C. Clay ..	4.45	5.77	9.09	3.91	6.11	8.52
Silt ..	1.37	1.55	1.85	1.66	1.67	1.69
Sand ..	1.15	1.20	1.08	0.77	0.95	0.78
Total from primary particles	6.97	8.52	12.02	6.34	8.73	10.99
D. b.e.c. of the soil assuming clay as the only active fraction	4.48	5.77	9.09	3.91	6.11	8.52

It will be interesting to note from data in Table III that invariably the base exchange capacity as found by actual analysis (B) is

lower than the sum of the calculated base exchange capacity of the different fractions (C). This difference between the two is certainly small but significant; this may be due to interaction between the different minerals present in the silt, sand and clay lattice. Further work is in progress in this direction.

The fourth contributory factor for base exchange besides clay, silt and sand is the organic matter. Base exchange capacity of the organic matter is expressed as the difference between the base exchange before and after hydrogen peroxide treatment of the soil. When the sum of the calculated base exchange capacities of the sand, silt and clay are deducted from the base exchange capacity of the untreated soil a figure is obtained which is expressed in Table IV as the base exchange capacity calculated from the primary particles (Y). Neglecting the exchange capacities of the silt and sand, if allowance is made for the exchange capacity due to clay alone the value obtained is expressed as base exchange capacity of the organic matter assuming clay to be the other active component (Z). If the entire base exchange capacity were due to clay alone then the exchange capacity of the organic matter should have been very high, but apparently this is not the case as judged from the data in Tables IV and V.

TABLE IV

Base exchange capacity of the organic matter

Depth	Manured			Un-manured		
	0-6"	6"-1'	1'-2'	0-6"	6"-1'	1'-2'
% Organic carbon present in the soil	0.448	0.324	0.194	0.251	0.213	0.182
*% Organic matter present in the soil	0.771	0.385	0.334	0.432	0.366	0.313
X A-B	2.10	2.60	2.01	1.20	2.19	1.51
Y A-C	0.43	1.08	1.48	0.66	0.47	0.51
Z A-D	2.95	3.83	4.41	3.09	3.09	2.98

* (Organic carbon \times 1.72 = Organic matter)

When items X, Y and Z in Table IV are expressed on 100 gm. organic matter as in Table V, a picture of the base exchange capacity of the soil organic matter is more clearly obtained.

TABLE V

Base exchange capacity of the soil organic matter in m.e. %

	Manured			Un-manured		
After H ₂ O ₂ treatment ..	272	675	602	277	598	482
Assuming clay as the sole active agent	382	994	1324	715	844	952
From primary particles ..	56	281	443	152	122	163

Figures for b.e.c. for organic matter after H₂O₂ treatment of the soil and after assuming clay as the sole active agent do not conform to the values recorded by Piper,⁵ Hosking² and others. It is only after allowing for the contribution for b.e.c. by sand, silt and clay we obtain figures shown as from primary particles in Table V which appears more correct and which also falls in line with the observation of other workers.

Our thanks are due to the U.P. University Research Grants Committee for an award of Fellowship to one of us (A.N.P.) which made this investigation possible.

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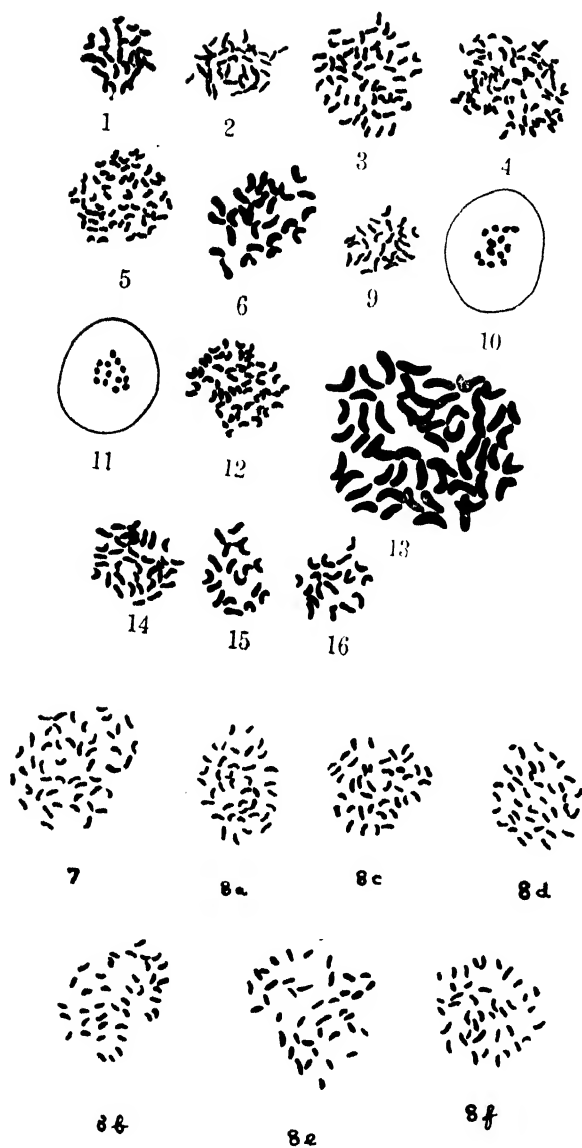
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A NOTE ON THE CHROMOSOME NUMBERS OF SOME ECONOMIC PLANTS OF INDIA

As was proposed in an earlier report¹ the chromosome numbers for such economic plants of India as are not known are being determined and reported from time to time. The present one is the second of such reports. Reference is made throughout to Chromosome Atlas² for numbers already published and also for genera and species whose numbers remain undetermined. The genera *Garcinia* and *Mangifera* are supposed to be apomictic. The former has

Species	Common Name	2n or n Number	Fig. Number	Remarks
1 Lauraceae :—				
<i>Persa drynifolia</i> Cham. & Schlecht. (syn. <i>P. gratissima</i> Gaertn.)	Mexican Avacado pear	2n = 24	1	Introduced, collected at Kallar, Nilgiris
2 Amarantaceae :—				
<i>Amarantus viridis</i> , Linn.	Plant of waste places, wild	2n = 34	2	Sometimes used for spinach
3 Oxalidaceae :—				
<i>Averrhoa carambola</i> , L.	The carambola fruit	2n = 24		Country of origin is not known
4 Guttiferae :—				
<i>Garcinia indica</i> , Choisy.	Kokum plant	2n = c. 54	3	Chromosomes small. Fruit and oil plant, Kallar
<i>Garcinia Mangostana</i> , Linn.	The Mangosteen	2n = c. 76	4	Chromosomes small. Fruit plant Kallar
<i>Garcinia speciosa</i> , Wall.	Palawa tree	2n = c. 55	5	Native of Barma and Andaman Islands. Timber and resin.
5 Burseraceae :—				
<i>Commiphora Berryi</i> , Engl.		2n = 26	6	A small, armed tree used as hedge plant
6 Meliaceae :—				
<i>Swietenia Mahagoni</i> , Linn.	The Mahogani	2n = 46-48	7	Introduced timber and avenue tree
7 Anacardiaceae :—				
<i>Mangifera indica</i> , L.	The Mango			Confirms number recorded by Janaki Ammal ² . Progeny of single plant
var. <i>Nadusta</i>	Nalusala or Peter	2n = 40	8a	12 seedlings were examined, all with same number
Inter-variatal crosses—F ₁ s :—				
Chinnaswamynarekha × Panchadarakalasa		2n = 40	8b	All F ₁ root materials collected at Kodur Fruit Research Station
Bargalora × Baneshan		2n = 40	8c	Fruit Research Station
Goa × Jehangir		2n = 40	8d	Goa is polyembryonic
5/12 Neelum × Muvandan		2n = 40	8e	Muvandan is polyembryonic
Interspecific crosses F ₁ :—				
<i>M. Zeylanica</i> Hook × Rumani		2n = 40	8f	<i>M. Zeylanica</i> is a wild type
8 Sapotaceae :—				
<i>Chrysophyllum Cainito</i> , Linn.	The West Indian Star Apple fruit }	2n = 24		Introduced fruit plant Kallar, Nilgiris
9 Oleaceae :—				
<i>Jasminum sambac</i> , Ait. var. Sujmallige	Indian Jasmine	2n = 26	9	Cultivated variety described in ³
<i>J. auriculatum</i> , Vahl.	Wild	n = 13	10	Collected near Kallar
<i>J. malabaricum</i> , W.	do	n = 13	11	Collected on Marudamalali Hills, Coimbatore
<i>J. rigidum</i> , Zenk.	do. bushy	2n = 26		do do at 2000 feet.
<i>J. angustifolium</i> , Vahl.	Wild as well as cultivated	2n = 52	12	Root tips from garden variety collected at Coimbatore
<i>J. calophyllum</i> , Wall.	do do	n = 13		Collected at Kodur. The plant resembles very closely cultivated species <i>J. flexile</i> , Vahl
10 Gramineae :—				
<i>Sorghum halepense</i> , Pers.	Wild Marudamalali 3000 feet	2n = 20		Confirms number recorded by Janaki Ammal ²
do	do Ponnuth, near Coimbatore	2n = 20		Tall, perennial growing upto 10-12 ft. height
do	form collected at Godavari	2n = 40		Similar to above.
do	form collected at Kodur	2n = 40		Medium height, perennial awned
<i>Pennisetum Hohenackeri</i>	Wild	2n = 18	15	Dwarf spreading type 2-3 feet height narrow, small leaved, awnless
<i>P. alopecurus</i> Nees. (syn. with <i>P. hohhenackeri</i> Hochst)	Wild	2n = 18	16	Confirms number recorded by Janaki Ammal ²
<i>P. polystachyon</i> , Schu.	Wild	2n = 54	13	Seeds from Ec. Botanist, Poona (Bombay Govt.)
<i>Setaria intermedia</i> , R & S.	Wild	2n = 36	14	Cultivated as fodder grass
<i>Echinochloa stagnina</i> , Beauv.	Wild	n = 27		Collected at Kallar
<i>E. colona</i> , Link.	Wild	2n = 48		Large, perennial, culms rooting at nodes, often submerged
				Paddy wet-lands, etc.



(FIGS. 1, 8a to 8f, 15 and 16— $\times 2480$; FIGS. 6, 12 and 13— $\times 4960$; the rest $\times 3300$.)

(FIGS. 1-6 and 9 to 16 reduced to $\frac{1}{2}$ the original size.)

1. *Persea drymifolia*; 2. *A. viridis*; 3. *G. indica* 4. *G. Mangostana*; 5. *G. speciosa*; 6. *C. Berryi*; 7. *Sc Mahagony*; 8a. *M. indica* var. *Nadusala*, 8b. Chinnas. uwarnarekha \times Panchdharakalasa, 8c. Bangalora \times L'aneshan; 8d. Goa \times Jehangir. 8e. 5/12 Neelum \times Muvandan; 8f. *M. Zeylanica* \times Ruman; 9. *J. samba* var. *sujimallige*; 10. *J. auriculatum*; 11. *J. malabiricum*; 12. *J. angustifolium*; 13. *P. polystachyon*; 14. *S. intermedia*; 15. *P. Hohenackeri*; 16. *P. alopecurus*.

a number of fruit and timber trees. A more detailed work is being done regarding these

two genera. The whole Natural Order *Burseraceae* is lacking in the knowledge on chromosome numbers, similarly the *Combretaceae*. A detailed work is being done in *Jasminum*. In this genus a few diploids and triploids were reported already.³ In the following are given the plants whose numbers are now reported.

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July 4, 1949.

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SOME OBSERVATIONS ON AN OBSCURE DISEASE OF PADDY: *ORYZA SATIVA*

THIS disease in Bihar is known by different local names, viz., *Dakhina*, *Ukra*, *Chatra*, etc. It is a common belief here that the disease generally makes its appearance in years of high flood. The outbreak of the disease is characterised by the general yellowing of the leaves and subsequent drying up of their tips. This drying up process gradually travels downwards. Ultimately the plants present a withered appearance. The yield is reduced according to the severity of the attack. In worst cases there is a complete loss of grains.

Hector² reported this disease from Bengal but its definite cause could not be ascertained. Wood-house³ observed that this obscure disease is widely spread in Bihar. He further stated that it is said that with the application of *Khari Nimak* (bazar sodium sulphate) the plants revive and put up new growth. Butler¹ stated that this disease is probably due to some physiological degeneration hastened by the action of some ill-defined conditions such as climatological, soil and cultural.

In a year of high flood at the Rice Experimental area at Sabour, this disease was noticed in a few plots. One of these plots, where the plants had become yellowish and their tips had begun to wither was selected to study the effect of the following chemi-

cals on this peculiar disease. By taking 40 lb. of *Khari Nimak* per acre as standard, the rates of the various chemicals were fixed as shown below:

TABLE I

Treatments	Rate of application
A. <i>Khari Nimak</i>	40 lb. per acre
B. Sodium sulphate	40 lb. per acre (13 Na : 9 sulphur)
C. Aluminium sulphate	40 lb. per acre (9 sulphur)
D. Ammonium sulphate	37 lb. per acre (9 sulphur : 8 nitrogen)
E. Ammonium chloride	30 lb. per acre (8 nitrogen)
F. Sodium chloride	33 lb. per acre (13 Na)
G. Control (No treatment)	

These chemicals were applied to the diseased crop in equal areas 5' x 7'. The treatments were randomised and replicated twice. Within four weeks of the application of these chemicals, the beds which received treatments A,B,C and D became green and had put up new growth. A couple of weeks later these beds showed no sign of the disease. Treatments E and F, however, showed some gradual improvement, which never reached a stage of complete recovery.

At maturity all the beds were separately harvested. The results obtained are stated below:

Treatment	Average yield per acre in lb.	% increase on control
A. <i>Khari Nimak</i> ..	1726	194.5
B. Sodium sulphate ..	1678	189.1
C. Aluminium sulphate	1505	169.6
D. Ammonium sulphate	1701	191.7
E. Ammonium chloride ..	1041	117.3
F. Sodium chloride ..	1002	112.9
G. Control ..	887	100.0

From the above statement it may be seen that *Khari Nimak*, ammonium sulphate, sodium sulphate, aluminium sulphate have given fairly good results—giving an increased yield of 94.5, 91.7, 89.1 and 69.6% respectively. Out of these treatments *Khari Nimak* has given the best result. Ammonium sulphate, however, has given the next best performance in yield. Ammonium chloride and sodium chloride have also given an increase of 17.3 and 12.9% in the grain yield respectively. When the results of the treatments A,B,C and D are examined in comparison with that of E and F it appears

that perhaps sulphates in the treatments A, B, C and D have something to do with the increased yield obtained with these treatments. It is with these treatments, as already stated, the plants had completely shaken off the symptoms of the disease. The soil analysis of the diseased plots has given an indication of sulphate deficiency. Diseased plant materials were examined for fungi, insects and eelworms, but nothing discriminating was found that could be held responsible for the symptoms.

Incidentally it may be mentioned that the diseased plants when uprooted and replanted in a disease-free plot quickly improved and shook off all signs of the disease, whereas those which were replanted in a diseased plot rapidly deteriorated.

Experiments to introduce this disease artificially by creating sulphate deficiency in the culture medium is in progress.

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SEED SETTING IN KUDZU VINE, *PUERARIA THUNBERGIANA*

KUDZU VINE (*Pueraria thurbergiana*) is assuming an increasing importance in the soil conservation programme as an effective soil binder; it also affords high bulk of very nutritious forage for the livestock. Its propagation on extensive scale has been handicapped due to its absence or poor seed setting ability.

Systematic work, carried out at Poona, to induce flowering in this species has proved inconclusive.¹ The only other record where the kudzu vine has flowered was at Pusa where the flowering was recorded by Joshi even in the first year.²

This vine has been under observation in the Agrostology Section of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi. A single plant received from Mr. N. V. Joshi, Poona, was planted in Mid. Block A3 on 18-10-'45. The growth was affected by frost during December, but

fresh growth was observed in the last week of January. The vine was manured with 4 oz. of ammonium phosphate on 16-1-'46; no manuring was done subsequently. Since then the vine has spread profusely; it suffers heavily due to frost in winter and puts on vigorous growth in spring.

For the first time flowering was observed on 8-9-'48, i.e., about three years after planting. Flowering was moderate and was observed on north-east to south-east aspect only. Shedding of flower was a rule, original purple colour turning into bluish after shedding. Natural pod formation was detected on 20-9-'48 on a shoot that happened to climb on a wire fence post. This pod was unfortunately found missing.

In order to understand the general failure of the effective pollination, the carpel was examined and it was found that the stigmatic surface was hard. Flowers on four separate inflorescences were pollinated artificially on 23-9-'48. One pod was observed on each of the two inflorescences so treated. The mature pods were small and contained only one seed each.

The vine remained dormant during winter months and started spring growth in February, 1949. Flowering was observed on 20-4-'49 and natural pod formation occurred by 1st week of July. There was considerable shedding of flowers as last year but the number of pods formed this year is about 8-10.

The formation of flowers and rods after the third year is in conformity with the recorded observations in U.S.A.³, where the seed formation in kudzu was found to be best in vines of over three years of age, climbing on small to medium-sized trees, in permanent pastures with deep soils.

My thanks are due to Dr. J. N. Mukherjee and Dr. T. J. Mirchandani for kind encouragement.

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tion by Kudzu (*P. thunbergiana*) in the South Eastern United States during, 1941," *Jour. of the American Society of Agro.*, 1942, 34-4, 389.

AN OIL-BEARING ALGA FROM THE PALANA LIGNITE (? EOCENE) OF RAJPUTANA

THE theory of the algal origin of bog-heads was first advanced by Bertrand and Renault¹ in 1892: the 'yellow bodies' of the Permian kerosene shales of New South Wales were described by them as remains of a microscopic alga, *Reinschia australis*; almost similar organisms found in the Carboniferous bog-heads of Scotland were also considered to be algæ, a species of *Pila*. The algal nature of bog-heads was later questioned by Jeffrey² who considered that the 'yellow bodies' were spores of higher plants. Later work by Thiessen,³ Zalessky,⁴ Blackburn and Temperley⁵ demonstrated that the bog-head fossils are algæ differing but little from the living species *Botryococcus braunii*,⁶ a colonial alga found in fresh and brackish waters. *Botryococcus* and its palæozoic allies, contain considerable oil and their sapropelic accumulations have given rise to bog-heads and other forms of bituminous coal. An ill-preserved yellow oil-bearing alga has been recorded by Down and Himus⁷ from the Eocene Kohat oil-shales; and more recently Lahiri⁸ has described supposed algal structures from the kerosene shales of the Saline series whose age is still a matter of controversy.



Botryococcus (?) sp. $\times 460$. From lignite (? Eocene)
Palana, Rajputana.

This note records the presence of oil-bearing yellow bodies similar to *Botryococcus braunii*, in a lignite from Palana,

near Bikaner. The bed of lignite which varies in thickness from a few inches up to 8 feet is overlain by a thick bed of Nummulitic Limestone. Lignite samples and the Nummulitic limestones were collected by S. S. Misra in 1948 from a section at Palana described by La Touche.⁹ The bed of Nummulitic limestone contains *Assilina spinosa* and *A. daviesi*, but *A. granulosa* is, however, not present. The Palana Limestone correlates with the Bhadrar beds, the highest Laki beds of the Salt Range and the underlying lignite is also probably Eocene in age, but no marine organisms were noticed. The lignite is made of lumps of resin, carbonised wood, cuticles, and spore exines (which are being studied by Dr. A. R. Rao).

A specimen of the alga recovered from macerations is shown in the accompanying photo. Each colony is more or less spherical in form with a central cavity surrounded by a zone of cells. Usually several colonies coalesce into a compound colony. The alga is oily-looking light yellow in colour, (a few are greenish), well-preserved and resembling *Botryococcus braunii* in structure and dimensions.

A detailed account of the Palana alga will be published elsewhere.

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Lucknow, September 8, 1949.

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COUMARINS AS NEW INDICATORS IN ACIDIMETRY AND ALKALIMETRY

HYDROXY-COUMARINS undergo colour changes at different pH values, e. g., 5-hydroxy-coumarins in alkaline solution¹ turn yellow, the colour being discharged on acidification: similarly, 7-hydroxy-coumarins exhibit blue fluorescence, which disappears on adding acid.

5-Hydroxy-6-acetyl-4-methyl coumarin² has been selected for investigating its use as an indicator. Alkalimetry turns it deep yellow, while it remains colourless in acids. Its 0.1 per cent. alcoholic solution has been used throughout this work. Various acids, and alkalies (HCl, H₂SO₄, HNO₃, succinic acid NaOH, KOH, Na₂CO₃) were titrated using the above solution as an internal indicator, two to three drops being added. The change in the colour of indicator was quite sharp. In all the titrations 5-hydroxy-6-acetyl-4-methyl-coumarin as an indicator gave results closely analogous to those for phenolphthalein.

Further work on the utilisation of other 5-hydroxy- as well as 7-hydroxy-coumarin derivatives is in progress.

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VANADAMETRY—PART IV

Volumetric Estimation of Hydroquinone by Sodium Vanadate

IN the reaction between hydroquinone and sodium vanadate, diphenyl benzidine serves as an excellent indicator at 50°C. in presence of oxalic acid as catalyst. 10.0 ml. of 0.05 M hydroquinone solution were taken and diluted to about 150 ml. followed by the addition of 5 ml. of 15 N sulphuric acid and 1.0 ml. of 0.1% indicator. To the mixture at 60°C., a known quantity of oxalic acid added. Then an equivalent Volume of 0.05 N vanadate solution (with a drop in excess) was added with brisk stirring and the time taken for the appearance of the blue-violet colour was noted. Experiments were carried out, varying the concentration of oxalic acid. The results are recorded in Table I.

The data show that diphenyl benzidine serves as a good indicator in the presence of oxalic acid at or above a concentration of 0.01N. We have also found that the end point will be sharply indicated when the overall concentration of hydroquinone

TABLE I

Volume of 1.0 N oxalic acid	Nil	0.25 ml.	0.5 ml.	0.75 ml.	1.00 ml.	1.5 ml.	2.00 ml.	3.00 ml.
Time of first appearance of blue-violet colour in the cold	No colour even after 10 minutes	45 sec.	45 sec.	42 sec.	40 sec.	35 sec.	30 sec.	30 sec.
Time of first appearance of blue-violet colour at 60° C.	Very faint blue-violet colour after 8 minutes	5 sec.	5 sec.	4 sec.	4 sec.	3 sec.	3 sec.	3 sec.

is under M/100 and the acid concentration is over 1.0 N. The results in Table II show that the vanadimetric method gives results in agreement with the ceric sulphate method.¹

TABLE II

Amount of hydroquinone in milligram mols.			
No.	By weight	Ceric sulphate method	Vanadimetric method
1	0.5000	0.4982	0.4994
2	0.4000	0.3980	0.3986
3	0.3653	0.3640	0.3638
4	0.3000	0.2989	0.2993
5	0.7306	0.7275	0.7290
6	0.5480	0.5466	0.5465

Although ceric sulphate is a convenient reagent for the estimation of hydroquinone, it is unsuitable for use in the presence of phenolic compounds, since it oxidises these phenols to coloured substances insoluble in sulphuric acid. We have now found that sodium vanadate gives accurate results even in the presence of phenol, *ortho*-cresol, *meta*-cresol and *para*-cresol, (Table III).

TABLE III

Phenolic compound added in milligram mols.		By weight	By vanadimetric method
Phenol	2.5040	0.3653	0.3638
	5.0080	0.3653	0.3638
	10.0160	0.3653	0.3638
<i>Ortho</i> -cresol	5.000	0.3653	0.3638
	10.000	0.3653	0.3638
	4.6660	0.3653	0.3638
<i>Meta</i> -cresol	9.3230	0.3653	0.3638
	2.5040	0.5480	0.5465
<i>Para</i> -cresol	5.0080	0.5480	0.5465
	10.0160	0.5480	0.5465

Resorcinol, however, undergoes induced oxidation by sodium vanadate in the pre-

sence of hydroquinone giving a deep coloured substance.

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August 22, 1949.

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NATURE OF ACTIVATED SLUDGE AND ITS BEARING ON DE-WATERING THE MATERIAL

ACTIVATED sludge derives its activity from its organisms of which the most important are certain ciliates, more especially *Epistylis* sp. and other *Vorticellids*. The protozoa occur abundantly, forming slimy growths tenaciously attaching to the sides of aeration tanks and other fixed and mobile surfaces, e.g., microscopic particles of more resistant forms of organic matter in the mixed liquor (Figs. 1-2). Colonial *Vorticellids* were found most efficient in "floc" and sludge formation. These organisms are sensitive to acids, alkalis and other chemicals in concentrations met with in certain trade effluents, and are readily stained by carbol fuchsin.

The protozoal growth (*Epistylis* sp.) when washed and suspended in H₂O, presents a fairly white, fluffy, mucus-like appearance and settles down rapidly and forms a compact gelatinous mass which, under anaerobic conditions, putrefies; when aerated, nitrifies forming a brownish deposit; and on oven drying, yields, a dark brown powder.

Unlike other types of sewage sludges, activated sludge is bulky, hydrophilic and richer in nitrogen. These properties are



FIG. 1. Photomicrograph of the protozoal growth (*Epistylis* sp.) occurring on the sides of the aeration tanks of the Activated Sludge Plant at the Indian Institute of Science, Bangalore. $\times 60$.



FIG. 2. Photomicrograph of an actively developing "floc" of activated sludge showing the growth of different species of *Epistylis* and *Vorticella* on a particle of sewage matter which acts as a suitable nidus. $\times 60$.

influenced by protozoal development, as seen below:—

	A thick culture of <i>Epistylis</i> sp. (the protozoal growth collected from the sides of aeration tanks and repeatedly washed in H_2O)	Thick activated sludge (by allowing mixed liquor from the aeration tanks to settle)*
Weight of the material taken ..	5.2 gm.	5.2 gm.
Volume occupied	10 c.c.	5 c.c.
Number of active <i>Epistylis</i> sp. ..	650,000	200,000
Dry weight (oven dry)† ..	0.29 gm.	0.30 gm.

* At the same time, one litre of the original mixed liquor was filtered through filter-paper (No. 41) and the filtered material was dried in the oven, the weight of the dry matter being 1.93 gm.

† A comparative study of the rates of drying of the two materials revealed that the protozoal material dried more slowly. The protozoal powder on analysis had the following percentages;—

Loss on ignition—96.5; Nitrogen—9.9; P_2O_5 —1.3; successive extractions with ether, alcohol and chloroform—10.8, 23.6 and 0.2 (respective extracts).

The above and earlier observations^{1,2} show (1) that the attached forms of protozoa are better adapted to function as a biological flocculant in the activated sludge process; (2) that the colour, composition and activity of the sludge are mostly derived from the protozoa in the sludge; and (3) that the main difficulty in de-watering the sludge is due to the presence of protozoa and other forms of life.

Thanks are due to Prof. V. Subrahmanyam, Dr. Gilbert J. Fowler and Mr. B. N. Banerjee for their interest; and to Dr B. R. Seshachar for assistance in taking the photomicrographs.

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REVIEWS

Living Mathematics. By R. S. Underwood and Fred. W. Sparks. (McGraw-Hill Book Company, Inc.), 1949. Pp. x + 374. Price \$ 4.00.

This is the revised second edition of a book which was first published in 1940. It is not a book for the high-brow and by *Living Mathematics* the authors do not mean any of the rapidly growing branches of modern mathematics such as abstract algebra and topology. The treatment is split into two parts of which the first contains exercises of the matriculation standard while the second, though advanced, falls short of the intermediate requirements. The subjects touched in the book are arithmetic, algebra, trigonometry, calculus and analytical geometry. The last chapter of the book is called *Extended Analytical Geometry—A New Field of Mathematics*. It is elementary and at the same time both novel and stimulating. The young student for whom the book is intended will find its value increased by the tables given at the end and by the special treatment of certain topics such as annuities. The style is a bit too lively for the immature 'teenager' and the interesting historical references and witty remarks, which vitalize the book, will be more appreciated by mature minds with an amateurish predilection for mathematics. But one danger of all such mixtures of words and symbols is that those who ought to be attracted by words are repelled by symbols while those for whom the symbolic operations are carried out find the running commentary brilliant but unhelpful. The book under review has been received well by the public in America and it will indeed be fortunate if we find in our country "businessmen, lawyers, doctors, painters and second-storymen who plead guilty to a mathematical flair" and who would read *Living Mathematics* with zest. At any rate the book can be read with interest and profit by many, particularly, in the training colleges for teachers.

It is in the best traditions of the McGraw-Hill Book Company that we find the printing and get-up of this book, and also the price. Many years ago, Stephen Leacock made fun of the ascetic simplicity of mathematical books. The colourful jacket of this book agreeably proclaims the arrival of the new æsthetic spirit in the mathematicians' camp.

V. V. N.

Solid Analytical Geometry. By Adrian Albert. (McGraw-Hill Book Co.), 1949. Pp. 162. Price \$ 3.00.

This forms an introductory course dealing with the equations of the straight line, plane and quadric surfaces. The treatment is lucid and refreshing, with a rigorous algebraical background for the introduction of co-ordinates, and the equations, of the curves and surfaces considered. One chapter is devoted to the study of the elementary properties of matrices and determinants and after introducing the matrices relating to orthogonal transformations and rotations about the coordinate axes, the reduction and classification of the quadrics and their "points and planes of symmetry" are discussed. The last chapter introduces homogeneous coordinates and the fundamentals of projective geometry. The last but one chapter dealing with "spherical coordinates" is an unusual feature. The commonly-called polar coordinates are called respectively *range*, *azimuth* and *elevation*, and are collectively designated as spherical coordinates. Rotations about the three axes of coordinates are respectively called *pitch*, *roll* and *yaw*, and their associated matrices are given. The chapter ends with the formulæ relating to gnomonic projections, and the idea of gnomonic charts.

A laudable though short work on geometry by a well-known algebraist, the book will receive the appreciation of algebraists as well as orthodox geometers.

C. N. S.

The Real Projective Plane. By H. S. M. Coxeter. (McGraw-Hill Book Company), 1949. Pp. 196. \$ 3.00.

This book presents the subject-matter of synthetic projective geometry in a very lucid and simple manner, developing the subject by a carefully chosen set of axioms of incidence and order. The development of the subject is primarily based on Von Staudt's definitions of projectivity and the conic. A projectivity between two ranges is a correspondence that transforms a harmonic set into a harmonic set. An involutory correlation or point-line correspondence is called a polarity and a conic is the locus of points that lie on their polars, or the envelope of lines that pass through their poles. The equivalence of these definitions with Poncelet's definition

of projectivity and Steiner's definition of a conic is worked out in a very elegant manner. There is a chapter dealing with "generalized projectivity" on a conic, and with the theorem that any projectivity on a conic determines a collineation of the whole plane. There are two brief chapters giving the fundamental ideas of affine geometry, which is projective geometry minus the line at infinity and Euclidean geometry which is affine geometry possessing an orthogonal involution. A list of properties of conics which can be considered as affine properties is worked out and properties of circles and some properties of conics are developed by the above conception of Euclidean geometry. The latter chapter fittingly ends with the proof of the focus-directrix property of a conic. In the last two chapters, "Analytical Geometry" is introduced in terms of the axioms and concepts of synthetic geometry, and is comparable to similar treatment in Veblen and Young's *Projective Geometry*.

The handy size of the book makes it a convenient text-book for explaining the fundamental concepts of synthetic geometry, after which the student can proceed to the vast sea of geometrical properties of the conic sections in other books wherein the methods of projective and metrical geometries are freely mixed up.

C. N. S.

Monomers, Section I. Edited by E. R. Blout, W. P. Hohenstein and H. Mark. (Interscience Publishers, Inc., New York, N. Y.), 1949. Price \$ 7.50.

This is a folder type volume of unbound fascicles, each containing anywhere from 30 to 60 pages and dealing with one of the following monomers: acrylonitrile, butadiene, isobutylene, isoprene, methyl methacrylate, styrene, vinyl acetate and vinyl chloride. All these substances, capable of addition polymerisation, have not only been employed in the study of the fundamental characteristics of the processes leading to the formation of high polymeric materials but are being utilised for the industrial production of fibres, plastics and rubbers of great technical value and practical utility.

Each monomer is presented, after a short introduction, under the following subdivisions: methods of preparation in the laboratory and on industrial scale, the most convenient and economical methods being indicated; purification and analysis according to the best procedures available; precautions in the handling

and transportation of the material; physical properties with accurate quantitative data and graphs; pertinent chemical reactions the monomer can undergo alone and with other substances, and polymerisation under various, experimental conditions of temperature, pressure or concentration, reaction medium, catalyst, etc. There is a table of contents at the beginning and a list of literature references at the end of the section.

All the chapters have been written by the research workers of the Institute of Polymer Research, Brooklyn Polytechnic Institute directed by Prof. H. Mark, except the chapter on methyl methacrylate which is by Dr. Corley of Polaroid Corporation, Cambridge, Mass. Accuracy and thoroughness of treatment of the subjects are guaranteed by the fact that most of these monomers have been investigated at the Institute itself. The authors have drawn freely not only from the information gathered at the Institute but also from the published scientific and technical literature and data supplied by industrial concerns. Little needs to be said about the editorial board headed, evidently, by Prof. Mark, an internationally recognised authority in the field of high polymer research and industrial practice, who is also editing, with others, a loose-leaf literature and patent service on Resins-Rubbers-Plastics and on Natural and Synthetic Fibres.

The purity of the monomer is of the utmost importance in addition polymerisation which is a chain process very sensitive to the presence of impurities which may act either as retarders or as negative catalysts. The information presented in this volume on monomers of scientific and industrial value will be welcomed not only by the research worker in the laboratory but also by the production engineer in industry. The volume will be particularly appreciated by research workers in India who have to prepare the monomers for themselves since they are not easily available.

No typographical or factual errors have been noticed, and the printing is of the excellent standard generally associated with Interscience publications. By way of information to prospective buyers, it may be added that articles on additional monomers (acrylic acid, esters of acrylic acid and esters of methyl methacrylic acid other than methyl methacrylate) now in active preparation and on others which may soon find place in industrial practice, may be conveniently added in the folder of the present volume and may be obtained as soon as they are published provided a standing order is

placed for them at the time of purchasing the present volume.

L. M. YEDDANAPALLI.

Tablet Making. By Arthur Little and K. A. Mitchell. Published by the Northern Publishing Co., Ltd., 37, Victoria Street, Liverpool, 1. 1949. Pp. 121 with 41 illustrations. Price 15sh.

During the last five or six years one is accustomed to come across frequently a new facile American expression, "The technical know-how". This expression really means a knowledge of the minutiae of process operations in a factory both from the point of view of theory and practice. The book under review, "Tablet Making" can truly be described as furnishing the technical know-how of all varieties of tablet making. A "high-brow" theoretical scientist may cynically lay aside this book as merely a compendium of catalogues of tablet-making machinery under the guise of a descriptive and practical text-book. We can conveniently ignore such critics and welcome this publication. That modicum of theoretical science necessary to serve as a background in the practice and art of tablet-making has been provided. Necessarily the mechanical and chemical engineering aspects of the industry have been given greater and detailed attention.

The various operations connected with tablet making like mixing, wet-granulation, drying, dry-granulation, lubrication, compressing, colouring and coating of tablets, etc., all have been dealt with lucidly and adequately. Since the use of tablets in confectionery, pharmaceutical and other trades has become enormous and since complicated "multi-punch" rotary tablet machines have come into use, complete details of the operations and care of such machines have been given. There are rotary tablet-making machines, for example, with $\frac{1}{2}$ -inch tablets, to produce 500 per minute or 30,000 tablets per hour, uniform in size and weight! None the less, even to-day, there is a need for hand tablet making in small establishments and this aspect has also received attention. A very useful part of the book is a chapter dealing with processing of various chemicals giving twenty-five examples of tablets with their component ingredients.

Having described the essential points regarding the manufacture of tablets, the authors take, as an illustration, the preparation of an Iodised Throat tablet (p. 36). Its manufacture is described in detail. This has been well done,

Take another example, "Wet granulation". Authors state as follows:—

"Looking back to the earlier days in the granulating room with the slow moving process of hand granulation and then to witness the speedy businesslike performance of the present-day oscillating granulator, one is compelled to pay tribute to the chemical engineering industry for this contribution to the problem of speeding up production and eliminating the drudgery from the granulation process. . . . The end of the day in the past found operators with aching arms and a feeling of boredom with the drudgery of the process. . . Times have changed. The modern oscillating granulator has revolutionised the granulating process. The batch which took two people hours to granulate in the old days now can be processed in anything from 20 to 30 minutes. A machine can be operated by a junior who merely presses the starting button and feeds in the moist material gradually. The result is perfect granulation by mechanical means in approximately one-fifth of the time. The advantage to the manufacturer in reduced overheads is obvious. The advantage to the worker both physical and mental can be appreciated by any person who experienced the old methods."

The pharmaceutical industry specially welcomes this book. The illustrations are all from one source. There is nothing wrong in this, but other sources of supply of mechanical equipment might have received some attention. For example, recently, claims have been put forward that the Jackson-Crokatt No. 4 granulator, starting with moist or sticky powders, will have an output four to five times that of any other granulator. Some advances have been made in "infra-red-ray drying". Probably no mention has been made since it does not yet find general acceptance in the trade.

The book is well printed and bound. The illustrations are clear and well chosen. But the price is rather on the high side.

S. G. SASTRY.

Annual Review of Physiology, Volume IX. (Published by the Annual Review Inc., & the American Physiological Society), 1949. Pp. vii+643. Price \$ 6.00.

The present volume is a select and critical record of the latest advances in several branches of physiology, and maintains its usual high standard. Exhaustive bibliography given under each subject adds to the usefulness of the Review.

Limiting itself to classical physiology, certain chapters, included in previous issues (e.g., exercise, anoxia, etc.) have been omitted. All contributors have recognized the role of physiology as a co-ordinator and interpreter of the living organism in health and disease, and accordingly its scope has been enlarged, and sciences often previously separated have been fused. Developmental physiology, by Schechtman deals with the physiology of embryonic differentiation. Certain topics, such as histochemistry of the ovary, enzymes and reproductive control have been touched on in the review on "Reproduction", by Catchpole. The discussion on the metabolic function of the endocrine system by Barker includes the recent development in the mechanism of hormonal effects. Insulin and carbohydrate metabolism, hormonal effects on phosphatases and arginase and studies on thyroid, pancreas, and adrenal and pituitary have been presented in detail. A survey of the pertinent literature on visceral and somatic functions of nervous system, bioelectric potentials in nervous system and muscle shows that a great deal of interest has been shown in these fields. Several useful reviews of the various aspects of the "Electrical Activity of the Brain" have appeared and the survey by Walter and Walter reflects a widening prospect of more fertile field. The 'Physiological Psychology' is the subject of an extremely interesting review by Harlow. The reviewer has surveyed the relevant physiological facts and theories and has given a systematic orientation to the study of psychophysiology. Alexander Sandow has mainly dealt with the fundamental problem of the contraction of skeletal muscles and the topic has been brought up to date in his review of the subject 'Muscle'.

The reviews of the cardiovascular system under the headings "Haematopoiesis", "Heart", "Peripheral Circulation" and "Lymphatic System" are critical and comprehensive, and present a clear picture especially with respect to anæmia and indicate the future line of investigation. Wyss has covered only the external or somatic respiration, particularly lung-breathing, in his article on "Respiration," and the effects of respiratory and other gases on the body tissues and organs have been purposely omitted. The clinical application of anoxia and mechanical effects of barometric pressure have only been briefly mentioned. The review on "Kidney" by Philips covers mainly the renal function — from foetal life through infancy, discussion on renal blood flow,

glomerular filtration and experimental induction of renal damage and its treatment.

Considerable interest is shown in biochemical and physiological research with the help of radioactive isotopes. Nims has reviewed the action of ionising radiation on living cells and has discussed the subject of whole body radiation and its effect on blood and hæmopoiesis, skin and other tissues. From the work done so far in radiobiology, it is evident that greatest advances will come, not from the use of isotopes as source of internal radiation, but from the employment of tracer techniques for understanding physiological disturbances and pathological processes. Nims has not attempted to cover the whole field but only touches the highlights in a highly suggestive and critical chapter on 'Radiation'. Teorell has reviewed the field of biological permeability. The physical chemistry of permeability and the cell and tissue permeability have also been referred to. Recent advances in pharmacology, physiology of hearing, vision, liver and digestive system are also included in this volume.

The *Annual* will commend itself to all investigators interested in the critical appraisal of the progress of physiology in its most comprehensive sense, and will prove indispensable not only to physiologists but also to those engaged in medical research.

N. N. DE.

Selected Topics from Organic Chemistry.
By Karve, D. D. and Advani. Publishers: M/s. Dastane Brothers, Poona 2), 1947. Pp. vi+418 Price Rs. 10.

In this concise volume the authors have presented the salient features of many important topics in Organic Chemistry, chiefly from the standpoint of University Examinations of the Pass and Honours degrees of Indian Universities. Generally speaking, the treatment falls considerably short of the Honours standards. But if the less important chapters (24, 25, 27, 28 and 31) could be replaced by more important ones the book might perhaps be brought up to the level of the "Recent Advances" series by Glasstone and others.

The chapter on carbohydrates confines itself chiefly to the chemistry of glucose and fructose, the disaccharides being considered only in outline, while the polysaccharides are entirely omitted. Considering the importance at present of the production of organic chemicals by micro-organisms, a brief account at least of the manufacture of acetone, butyl alcohol, lactic acid, citric acid, gluconic acid, sorbose, etc., should have found a place in the chapter

on Fermentation and Enzyme action. Baeyer's Strain Theory has not received adequate treatment under Polymethylenes, particularly its limitations. Ruzicka's work on civetone and muscone could have been given in some detail as confirming Sachse and Mohr's theory of strainless rings.

Only a few terpenes regarded as important from the examination point of view have received attention. The interrelationship of carvone, terpineol and dipentene and their interconversion might have been indicated. Synthesis of terpenylic acid is better located on p. 62 than on p. 71. Synthetic substitutes of rubber deserve ampler treatment. The recent synthesis of nicotine is an unfortunate omission. There is a tendency to omit the names of chemists responsible for partial or total synthesis (Robinson's *Synthesis of Tropine*, p. 114, for example). It is gratifying to note that the recent synthesis of quinine by Woodward and Doering has found a place though the names of the authors have been omitted. Flavones, flavonols and anthocyanins form a natural group on account of their close relationship. The chapters on dyes and, colour and constitution could go together. The chemistry of indigo should have been discussed at greater length giving the latest developments in manufacture and its use at present in the solubilised form. The newer method of manufacturing anthraquinone from o-benzoyl benzoic acid dispensing with anthracene as raw material might have been given. The chapter on drugs is good but a more detailed account of the sulfa drugs is necessary. Vitamins and hormones have been dealt with rather briefly. Students would appreciate a clear and lucid account of the theory of resonance and its applications in structural organic chemistry. The chapter on physical properties and chemical constitution may be restricted to such properties as are applied at present for solving problems of chemical constitution, with mention of specific cases where they have been of help in deciding chemical constitution. Electronic interpretations of some of the reactions or later ideas of reaction mechanisms should have been indicated in the chapter on condensations and other reactions.

On the whole, the authors have given as many useful facts as possible under each topic, to make it useful from the standpoint of examinations, but the more enterprising class of students would appreciate a fuller treatment. References to literature would enhance the value of the book and the errata list which is

really too long will no doubt be reduced to the minimum in the next edition. M. V. S.

Botulinum Bacilli and Their Occurrence in Sweden. By John Fahraes, Stockholm. 1949.

This beautifully got up monogram on *Botulinum bacillus* gives an exhaustive review of the subject since its discovery by Ermengem. One interesting feature of various strains, A, B, C, D, E, etc., is that their biochemical activity such as carbohydrate fermentation and proteolytic activity is a function of the locality of occurrence. The organism is anaerobic, spore-forming gram-positive bacillus, the spores being highly heat resistant. The pathogenicity is due to toxin whose maximum titre was obtained in peptone broth or in coagulated protein and peptone at 25-30°C. The toxine is heat labile, acid resistant but sensitive to alkali, therefore is absorbed in the stomach and duodenum when ingested. Chickens, pigeons, cats, rabbits and guinea pigs are found to be sensitive to it. Chickens have been found to become paralysed and dying from consumption of food remains which have caused human intoxication. The organism has been isolated from the intestinal contents of birds dying of botulinum. The toxic effect is most marked in the central nervous system in the bulbar region of the pons neucleii and anterior horn of the cord. Some workers have observed noticeable effect on autonomic nervous system. In guinea pig dying from this toxine miliary necrosis of the parenchyma of the liver was observed by some workers. The toxic effect is due to the toxine. The organism is a saprophyte found in soil and in excreta of pigs and birds, etc. Epidemiological data regarding mode of infection have been well described, the organism being imbibed through contaminated meat, pork, fish and even vegetables particularly beans manured with contaminated faeces. The toxine can withstand freezing, if incorporated in fruits and vegetables previous to freezing. Their distribution in different soils and epidemiological bearings are admirably described. Workers interested in food poisoning and similar clinical conditions will find the monogram is very valuable. K. P. MENON.

A Mathematical Theory of Shaded-Pole Motors. By Erik Morath, *Transactions of the Royal Institute of Technology*, Stockholm, Sweden, Nr. 26, 1949.

The history of shaded-pole motors started in 1894 when it was found that by short circuiting

a portion of the pole, a salient pole squirrel cage motor could be run on single phase. The saving in cost due to this winding and a centrifugal starting switch compared so favourably with the distributed field winding that the 'shaded' pole motor has held its field over all the other types of single phase motors below 1/20 H.P. W. G. Morill (*Trans. AIEE*, 1929, 48, 614-29) has done pioneer work in the field of fractional horsepower motors and has in his AIEE paper ably analysed their characteristics with the aid of the Double Revolving Field Theory. Interesting methods of determining the starting and running performance characteristics of the shaded pole motor both theoretically and experimentally has also been published by F. H. Trickey (*Trans. AIEE*, 1947, 66, 143).

In the present monograph Mr. Morath has successfully applied this two-rotating-field theory to the solution of shaded pole-motors.

The author has started with certain basic assumptions and presented the equivalent circuits of the motor, thus providing a powerful tool in the hands of the design engineer for studying the effects of motor constants. The first section of the analysis is confined to the fundamentals of the m.m.f. curves and then effects of harmonics are dealt with under a separate heading.

The analysis is supplemented by experimental curves and compared with computed values. The effects of coupling factor, shading coil arc, resistance of shading coils, etc., on the performance characteristics of the motor have been graphically represented. The author has not, however, indicated in his paper how the constants of the motor have been determined, except for the statement that these are determined in the usual way. None of the papers on the subject has indicated the method for the determination of the constants.

Although the shaded-pole motor is the simplest of all the single phase motors so far as construction is concerned, it is the most difficult to analyse from the mathematical standpoint. The author's approach to the problem marks really a milestone in the design of shaded-pole motors. The subject has been treated in an able manner. The material covered is of interest to the academic men as well as to the design engineers. The author is to be commended for this fine and useful work.

C. S. G.

Pulses and Transients in Communication Circuits. By Colin Cherry. (Published by Chapman & Hall Ltd.). Pp. 312. Price 32sh. net.

The study of television, pulse modulation, radar, picture telegraphy and similar subjects involves a thorough knowledge of transient response of networks. When dealing with these subjects one is generally confronted with the problem of waveform distortion. In such cases it is not sufficient to know only band-width but also the knowledge of the response to waves of given shape—pulse or steepedged waves—is essential. A great mass of literature has accumulated concerning the transient behaviour of communication circuits but most of the information concerned therein is expressed in the form and style of the professional mathematician. This creates difficulties for engineers accustomed to the ideas and practices of sine wave type technique and who want to supplement their knowledge of steady state circuit theory by a study of transients. This book which is an introduction to circuit transient analysis for communication engineers will serve to bridge the gap between the conventional method of a.c. theory and operational methods of analysis.

The first chapters after briefly reviewing some of the fundamental ideas, such as laws of network behaviour, impedance functions, free and forced oscillations in a mesh, etc., establishes the physical ideas behind the solutions of differential equations associated with linear circuits and explains the difference between initial impedance and steady state impedance. In a.c. vector theory both trigonometrical and exponential notations are used. Chapter 2 points out the convenience of using the latter notation. After explaining the conjugate vectors the chapter deals in more detail with the frequency spectra of modulated waves, pulses and transients by means of Fourier analysis. In practice all wave forms are produced by some types of electric circuits. The steady state characteristics of circuits form the subject-matter of the next chapter. After classifying the networks into different groups and dealing with several definitions such as transfer functions, transfer impedance, etc., system of conjugates is applied to explain the selectivity characteristics of communication networks. After considering the effects of dissipation on the steady characteristics, the chapter concludes by discussing the "low pass-band pass analogy".

The complete steady state characteristics discussed in Chapter 3 may be utilised to determine the response of communication networks to a transient wave, provided the magnitude and phase shift distortion of every Fourier component in the applied transient introduced by the network be considered. Chapter 4 is concerned with the response of networks. The spectrum of output response transient involves Fourier integral. In many cases, evaluation of Fourier integral becomes difficult. So the method of attack to determine the transient response of a network by means of steady state characteristics is limited. However, the ideas behind the method are of great importance and can be made useful for practical computations of transient response which can be extremely helpful for finding an approximate answer. Two examples, 'response of a network to a symmetrical driving waveform' and 'response of a network to a skew-symmetrical driving waveform' elucidate the usefulness of trigonometrical notations as they make more apparent the symmetry relations between the components of spectra and of network characteristics. The case of a resistance loaded tetrode amplifier with regard to its response to transients has also been considered by Fourier integral as an illustration. The response of a linear network to a transient having complex wave forms, which, if not possible to be expressed analytically, may be derived by considering the transient to consist of a number of step waves of suitable amplitudes and times of starting. By finding an analytical expression for the response of a network to a step wave, it is possible to find the response to other transients of known analytical form by means of Hamel's integral, provided the integral can be evaluated. The step wave is a basic wave form in circuit transient analysis and from this point of view, this method merits attention. The chapter ends with a consideration of the circuit response to an extremely short pulse. It is sometimes necessary to know the general points regarding band width or build-up time instead of exact transient response. Chapter 5 deals with the approximation which simplifies to a great degree the calculations of transient response. It is also shown how by assuming certain geometric shapes of characteristics, soluble Fourier integrals may be obtained and the relation between band width and build up time can be determined with comparative ease. In television and radar channels it is necessary to produce certain desirable forms of response characteristics with a number of amplifier

stages. Chapter 6 is concerned with the transient response of multistage amplifier consisting of tetrode or pentode valves with particular reference to accuracy of signal reproduction. At the end of the chapter, signal to noise ratio and band width is discussed. Chapter 7 discusses thoroughly the effects of unequal distortion of sidebands of an amplified modulated carrier and a method has been described by means of which distortion of steady state signal or transient wave with any depth of carrier modulation and any type of channel characteristics may be calculated. This chapter requires a careful study. In the last chapter response of communication networks to very short impulses has been dealt with. This chapter introduces the idea of echoes to explain clearly the physical meaning of signal distortion and gives a clear picture of Fourier Transforms, avoiding at the same time mathematical complexities. This book ends with an appendix on the probability function response characteristics.

It is hoped that this book with its careful and lucid expositions of a difficult subject, will prove to be a very important and useful contribution to scientific literature. The author is to be congratulated for his successful attempt in presenting a clear physical picture of transient analysis. This book is strongly recommended to those especially who are engaged in radar and television work.

S. K. C.

The Floral Year. By L. J. F. Brimble.
(London: Macmillan & Co., Ltd.), 1919.
Pp. xiv+622. Illustrated 30sh. nett.

The Floral Year is a book which may be appropriately described as nature's pageant of colour in print. It is a fascinating book which takes one closer to nature in a more pleasing way than many other books on natural history can do. It has the touch of an artist apart from that of a botanist. Mr. Brimble, the author, who is well known for the several popular books written on botany, will now increase his popularity by bringing out this book which is different in many respects. Even popular books on plants have to conform to some system or classification in their treatment but *The Floral Year* follows more the nature's calendar which is more flexible than the rigid calendar of an astronomer. It is nature's floral almanac which obviously cannot adhere too rigidly to say set rules but all the same appears to con-

form generally to seasonal influence in a broad sense.

The author's treatment of the floral march or procession commences with the winter season symbolically the quiescent or the passive period of nature, when nature reveals more of its bleaker aspect and progresses through the spring and autumn which bring forth the richness and grandeur of the plant world. The autumn culminates in the mellow and subdued aspect of nature, rich in its bounty of ripened seeds and fruits and the gathering harvest. The pageant reveals that there is colour almost the year round. Even at the peak of winter season there is enough colour observed in the dark green of the yew, the scarlet berries and the glassy green leaves of the holly and the snowwhite berries of the mistletoe which decorate the homes at Christmas-tide. The winter scene outlining the trees and shrubs shrouded in a mantle of white revealing the outline of every twig is something majestic and unforgettable.

This fascinating book is enlivened by beautiful verses from such great authors as Chaucer, Shakespeare, Wordsworth, Gray, Milton, Goldsmith, Shelley, Keats and Whitman, Coleridge Bridges, Sack Ville-West, Walter-De La Mare and many others. All this is beautifully blended with information on the season of the year, the general characteristics of the plant, the peculiarities of the habitat and the uses of the plants that flower in different months beginning with January.

In the introductory chapter the author gives in brief non-technical terms, the botany, to enable the amateur to get a knowledge of the different types and parts of plants, the life-cycle including the processes of formation of flower and fruit and lastly the classification.

The book contains a large number of good illustrations and 24 very beautiful coloured plates. This book should be welcomed by all lovers of plants, both amateur and professional and it should find a place on the library shelf of all colleges and schools.

The excellent get-up leaves nothing to be desired.

L. S. S. KUMAR.

Essentials of General Cytology. By R. A. R. Gresson (Edinburgh University Press, Edinburgh), 1948. Pp. ix+184. Price 21 sh. net.

The Edinburgh University Press have issued a book on the general cytology of plants and animals as No. 2 in the series 'Science and Mathematics'. The book has been prepared by

Dr. Gresson with contributions on plant cytology by Helena Heslop Clark. The book is intended to give a groundwork on both animal and plant cytology and deals with nuclear as well as cytoplasmic structures.

In a subject of such vast scope each author has to make his own choice as to what he is to retain and what to omit. The present book deals comprehensively with microscopic structure and omits much of physiology and biochemistry of the cell. A student who wishes to specialise in microscopy will find the essentials clearly presented, and as intended, the book will be helpful to teachers of this subject. Three aspects of cytology get detailed treatment, the chromosomes in relation to heredity, structure of Golgi material, and morphology of reproductive structures in plants. There are brief chapters on cytology of Protozoa and cytology of pathological animal cells.

The author's special subject Golgi Material gets detailed treatment, and in comparison to this topic, the other subjects are briefly discussed. The space devoted to reproduction in plants could have been better devoted to more rigorous treatment of connection between Mendelism and chromosomes, for, the first mentioned subject is fully dealt with in textbooks of Botany. The groundwork in Genetics becomes important if the chapters on chromosomes and evolution, and cytoplasm and heredity are to be useful. In this manner it is possible to mention other topics worth greater detail, e.g., chloroplasts, plant cell wall, or the enormous variation in differentiated plant or animal cells. However, Dr. Gresson's selection is a welcome addition to books on cytology.

The illustrations and plates of microphotographs are excellent and would be of great use to the student. As indicated in the jacket, the book represents the highest tradition of Scottish typography. Only error detected was in p. 161 para 5 where 10 grams is stated and 1 gram is probably intended.

C. G.

A Study of the Influence of Impurities in the Solvent on the Induction Periods, and Rate of Formation of Grignard Compounds.

Making a systematic study of the course of the Grignard reaction, H. Mackle (*Proceedings of the Royal Irish Academy*, Volume LII, Section B, No. 4, December 1948) has shown that when the reaction was carried out in commercial ether dried over sodium wire, the induction period was 14.3 minutes. With ether purified elaborately by successive treatment with

water, potassium bicarbonate solution, saturated mercuric chloride, strongly alkaline potassium permanganate and concentrated ferrous sulphate solution, and then washing with water and drying and distilling over sodium, the induction period was only 5.1 minutes. When ether purified as above and then once again distilled over MeMgI was used, in addition to the reduction in the induction period, the yield also increased considerably.

The author has confirmed that the Grignard reaction proceeds much slower in benzene than in ether.

A simple method for measuring the relative induction periods and relative rates of formation of Grignard compounds is described and the mechanism of their formation is discussed.

B. H. IYER.

SCIENCE NOTES AND NEWS

Hospital Section for P.A.S.B.

The Pan American Sanitary Organisation, which is also the Regional Office of WHO, is establishing a new section to deal with the problems of surveying, planning, equipping, and modern methods of administration and management of hospitals of the participating governments. Mr. Felix Lamela has been appointed its Chief, with offices at the P.A.S.B. Hqrs. at Washington D.C. The immediate programme of activities includes the organization of the Third Inter-American Institute for Hospital Administrators which will be held in Rio de Janeiro, Brazil, in April 1950. The Brazilian Government, through the Ministry of Education and Public Health, has appropriated the sum of 300,000 cruzeiros (\$ 15,000) as grant-in-aid to cover in part the cost of organization of this short, intensive academic course of study for hospital administrators of the Western Hemisphere. A prominent group of outstanding educators of the leading educational institutions will form the faculty.

Decrease in Solar Activity

The Kodaikanal Observatory (Annual Report, 1948) observes that the sunspot activity reached its maximum by the middle of 1947 and declined in 1948; and that there has been an equatorial drift of the zones of maximum sunspot activity and a poleward drift of the zones of maximum prominence activity. Twice in 1948, the sun's disc was free from spots unlike the previous two years. Visual and photographic observations of the brilliant comet which appeared in the southeastern sky at dawn in November 1948 were made between November 11 and December 14. The magnetic observatory has a project to correlate solar phenomena with terrestrial magnetic disturbances.

M.Sc. Degree Award

On the recommendation of the Board of Examiners the thesis entitled "Histological Study of Endocrine Organs of *Pteropus Edulis*" by Mr. C. Sectaramayya, M.B.B.S., has been declared to qualify for the M.Sc. degree in Physiology of the Andhra University.

National Nutrition Association of India

The All-India Nutrition Board, founded in 1936, has been reconstituted into the National Nutrition Association of India. Its inauguration was held on 3rd September at Darbhanga Hall, Calcutta. Dr. A. C. Ukil, welcoming the delegates, referred to the import of 4-5 million tons of cereals costing about Rs. 250 crores.

The Honourable Raikumari Amrut Kaur inaugurating the session discussed how the newer knowledge of Nutrition could help to improve the diet of the lower economic groups. She urged the greater use of subsidiary foods, like sweet potato flour, defatted groundnut cake and potato, with a view to conserve foreign currency.

During the session symposia on (a) Food processing and Food supplements, (b) Population, Production and Public Health, (c) Nutrition Research, were held.

Award for Wool Research

Mr. T. MADHAVA MENON, M.Sc. (Leeds), Professor of Applied Chemistry, Maharaja's College, Ernakulam, has been awarded a Certificate of Merit and Silver Medal by the Worshipful Company of Woolmen of Great Britain in appreciation of his thesis on "The Supercontraction of Animal Fibres". Associated with this award is a money prize offered by the British Wool Federation.

UNIVERSITY OF BOMBAY

DEPARTMENT OF CHEMICAL TECHNOLOGY

Applications are invited for the post of Singhane Lecturer in Industrial Optics in the scale of Rs. 200-20-400-25-500. The post carries the usual dearness allowance and the benefits of the University Provident Fund. The Lecturer must possess a postgraduate research degree in physics with specialisation in spectrophotometry and colour physics.

Six typewritten copies of the application made on the prescribed form, with six copies of testimonials, should be forwarded so as to reach the Registrar, University of Bombay, Bombay I, on or before the 14th December 1949. Further details and forms of application can be had from the Registrar.

S. R. DONGERKERY,
University Registrar.

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[No. 11

	PAGE		PAGE
"Create More Wealth " ..	393	<i>Oscillations of the Earth's Atmosphere</i>	
<i>Indian Scholars in Australia</i> ..	394	K. R. RAMANATHAN ..	398
<i>Nobel Awards for Physics, Chemistry and Medicine, 1949</i> ..	395	<i>Obituary—Sir Ardeshir Dalal</i> ..	399
<i>Indian Science Congress, Poona</i> ..	395	<i>Fiat Reviews of German Science</i> ..	399
<i>The Institute of Palæobotany, India</i> ..	396	<i>Letters to the Editor</i> ..	400
<i>Rural Adult Education</i> ..	397	<i>Reviews</i> ..	419
		<i>Science Notes and News</i> ..	421

"CREATE MORE WEALTH"

IN the course of his stirring message to the Nation, Sardar Vallabhai Patel, Deputy Prime Minister of India, has called upon his countrymen to "produce more, spend less and waste nothing". Freedom from political bondage has been won; the economic freedom which is the basis of national prosperity and political stability has still got to be achieved, if we are to consolidate ourselves as a free and independent nation. In the attainment of economic independence, the resources of science and technology have to be mobilised and harnessed. Addressing the convocation of the Benares University on the 20th of this month Mr. K. M. Munshi, our scholar-statesman, declared, "In India population is increasing; food supplies are tragically short and our command over technology remains rudimentary. Science, therefore, for us is not a matter for luxury; it is a matter of life and death." On the same day at Delhi, Pandit Nehru addressing the citizens of the Metropolis, appealed to his audience to make the country self-sufficient with regard to food. Importation

of food, he said, is a waste of national wealth.

The gravity of the economic crisis that faces us and the immensity of the task that lies ahead has been repeatedly emphasised by our leaders and industrialists. The time has come for clear cut policies and for strong and determined action. Speaking about food production Sardarji appealed for the co-operation of every citizen. "We have in hand so many schemes of irrigation. We have a huge area of cultivable waste which is waiting for the hands that can plough. Even the areas under cultivation can, with diligence and well directed efforts, be made to yield more. We have a big reclamation programme which is being financed from the money that we borrowed from abroad. In addition, we have programmes for subsidising schemes of food production. If we can concentrate on all these, I have no doubt that, in spite of the economic situation of to-day, we can produce enough to feed ourselves and reduce the heavy drain of freight and profits which we obligingly

remit to foreign growers and shippers. Just think of it. If we had at our disposal the amount which we have spent on food imports during the last three years, we would have completely rehabilitated those unfortunate brothers and sisters of ours who have had to leave their hearths and homes in Pakistan and who are still looking up to us for relief and succour. It bleeds my heart to see so many unfortunate countrymen living in conditions of filth and poverty. Let those, who pass by them, reflect for a moment how they themselves are contributing to their misery by failing in their duty to help themselves and help us in ensuring self-sufficiency in food."

Appealing to industrialists and labour, Sardar Patel said, "Government, industry and labour must all play the game in a spirit of national service. We must all have the fullest sense of national emergency; we must close our ranks as we do in the presence of a common danger; we must tighten our belts to give the nation the tribute we owe to it; we must all contribute our might to the creation of that huge reservoir of funds, both here and abroad, which we need to back our national effort for a happier and better state of living. Who flourishes if the

country sinks into economic slavery? Who sinks if the country prospers? Let that be our ruling sentiment, let that be our ruling thought. Let industrialists concentrate on getting the maximum out of their plants and machinery; let labour lend its helping hand to the industrialists to exploit their resources to the maximum national advantage. It will be government's duty, which they must discharge, to ensure that the decks are cleared for action and there are no impediments, no bottle necks and no red-tape. The wheels must move with clock-like precision and perfect smoothness and there must be no mutual fault-finding. The tradesmen have also to do their part. It is their duty to ensure that the produced articles reach the consumer with the minimum of difficulty and at the minimum of extra cost. In such an inexorable and unrelenting struggle for existence, mercenary motives must not be allowed to rule to the exclusion of patriotic duty."

In this hour of grave emergency, the scientists and technologists should play their full part and extend their active support in implementing development programmes directed towards the liberation of our motherland from economic bondage.

INDIAN SCHOLARS IN AUSTRALIA

ONE of the practical outcomes of the Australian Goodwill Mission which visited India last year, is the grant of Fellowships to Indian students to enable them to carry out post-graduate work in Australia (*Curr. Sci.*, 1948, 17, 232).

One senior and two junior fellowships for the year 1949-50 have been granted by the Australian Government to three Indian scientists. The Government of India are proposing to reciprocate this enlightened gesture by granting similar Fellowships to Australian workers in science, for study at research centres in India. The period of study in Australia extends from six months to two years; all expenses including those of travel from the home country are met by the Commonwealth.

Dr. K.-V. Krishnamurthy, who holds the senior fellowship, is carrying out investiga-

tions on the native flora and breeding in commercial crops at the Botany School of the University of Sydney. Messrs. P. K. Shukla and Tejwani are the other two. The former is studying the cytogenetics of linseed in Waite's Agricultural Institute in Adelaide, while the latter is specialising in Agricultural Chemistry at the same centre of research.

The scholars are full of praise for the excellent arrangements which have been made by the Commonwealth Government to make their stay pleasant and fruitful. We learn that during the next year five instead of three are to be invited. The selection of candidates will be made by the Education Ministry of India; the final choice will however rest with the Commonwealth Selection Board, Australia.

NOBEL AWARDS FOR PHYSICS, CHEMISTRY AND MEDICINE, 1949

THE Swedish Academy of Sciences has awarded the Nobel Prize for Physics to Prof. Hideki Yukawa, the distinguished atomic scientist, now on the staff of Columbia University, N.Y.

As early as 1935, Prof. Yukawa introduced a new field of force, responsible for short-range interaction of the neutron with the proton, but different from the so-called neutrino-electron field. Its most important consequence was that the field should be accompanied by new types of quanta, obeying Bose statistics and each having the elementary charge $+e$ or $-e$ and proper mass m_{π} about 200 times that of the electron. The subsequent discovery of mesons in cosmic radiations with mass about 200 times the electron mass has confirmed that these mesons are identical with the quanta associated with the nuclear field. His other outstanding contributions include those on Dirac's generalised wave equations, slow neutrons, theory of β -disintegration, γ -ray encounter, scattering of mesons by nuclear particles, etc., etc. Dr. Yukawa is the first Japanese scientist to be awarded this exceptional and world renowned distinction.

The Nobel Prize for Chemistry of this year has been awarded to Dr. Williams Francis GIAUQUE, Professor of Chemistry, Berkeley, University of California. For his invention and first application of adiabatic demagnetisation method of producing low temperatures below 1° absolute, he was awarded the Chandler Medal of the Columbia University in 1936; and for his

discovery with Dr. H. L. Johnson of Oxygen Isotopes 17 and 18 by means of absorption of sunlight in the earth's atmosphere, he was awarded the Elliott Cresson Medal of the Franklin Institute in 1937. He has been a member of the American Philosophical Society since 1947.

His publications include many papers on the third law of thermodynamics; application of spectroscopy and quantum statistics to calculation of chemical equilibria; and low temperature calorimetric investigations of condensed gases.

The Nobel Prize for Physiology and Medicine has been jointly awarded to Dr. Walter Rudolf HESS, Swiss Physiologist, Director of Physiological Institute, Zurich University, and to Dr. Antonio CAETANO DE ABREU FREIRE EGAS MONIZ, skilled neurologist of Lisbon University.

A specialist in the circulatory and nervous systems, Prof. Hess has studied the reactions of animals to electric shocks and has been able to determine how parts of the brain control organs of the body.

By applying electrodes to different parts of a cat's brain and by stimulating, he was able to reproduce specific normal responses to external stimuli in the animal.

Dr. Moniz, famous neurologist, was the first to work out the way to treat psychosis by prefrontal lobotomy, by which important nerve connections in the thalamus and prefrontal lobe can be severed so as to provide relief for schizophrenics and maniac depressives. Dr. Moniz is the first Portuguese to be awarded the Nobel Prize.

INDIAN SCIENCE CONGRESS, POONA

THE 37th Session of the Indian Science Congress Association is due to be held at Poona from January 3 to 8, 1950 under the presidency of Professor P. C. Mahalanobis, F.R.S.

The executive committee of the Association has planned a detailed programme to cover all branches of Science.

Distinguished scholars and administrators from many parts of India are expected to attend. A number of distinguished foreign scientists from the U.K., the U.S.A., France and the U.S.S.R. have also been

invited. Information has been received that Professor Desmond BERNAL of Birbeck College, University of London, Sir Robert ROBINSON, President of the Royal Society, accompanied by Lady Robinson, the Atomic Physicists Professor Joliot-Curie and Madame Joliot-Curie, Prof. Herman MARK, who is an authority on Polymer Chemistry, and Dr. E. U. CONDON, Director of the National Bureau of Standards, Washington, will attend the session. It is also hoped that Prof. W. A. ENGELHARDT, Pavlov Institute of Physiology, Academy of Sciences, U.S.S.R., will come.

THE INSTITUTE OF PALÆOBOTANY, INDIA*

AT this solemn hour, in the presence of this distinguished gathering, it is my special privilege to request the Prime Minister of India to lay the foundation-stone of the new buildings of the Institute of Palæobotany.

This is in some ways a unique occasion. For, this Institute is the first and only one of its kind in the world. And in asking you, Sir, to do us this great honour I feel I have something of a personal claim upon you.

Palæobotany is the common ground between Botany and Geology—it is in fact the botany of the rocks. As one who has had to do with the creation of this Institute and with the direction of its activities during the past few years I may be allowed briefly to explain that here we study not only fossil plants but also the rocks in which they are found. Experience has taught us that it is only thus that we can form anything like a full picture of plant life through geological time.

In the same way as a child's walk is made up of a series of falls, the edifice of Science is erected upon a series of mistakes.

The Science of Palæobotany began somewhat like a purely academic pursuit, a study of curios. Gradually the point of view has changed as it always does with time, and it has revealed new vistas. The whole outlook has now widened beyond recognition. To-day the study of fossil plants, pursued with modern techniques and with due regard to its repercussion, upon all the bordering sciences, already occupies a respectable place among the sciences and fully deserves the support that it is now receiving from all sources. It would not only allow us glimpses into the evolutionary history of plants, but helps us more and more accurately to tell the ages of strata and thereby to explore the mineral wealth of the earth, particularly coal and oil, to picture the geography of the past, and to understand the structure of the earth's crust with its recurring phases of

earth movements some of them affecting entire continents.

With modern methods of study, geological formations many thousands of feet thick which geologists were accustomed to regard as barren of fossils and therefore not datable, have been shown to be teeming with microscopic fossils which have thrown a flood of light upon their geological age, and have given us improved methods of classifying the oil-bearing strata.

The stone, which it will be my privilege now to ask you to lay, is a somewhat unusual sort of monument. It has been purposely made up in this Laboratory from an assortment of rocks and fossils from many different countries, and from many geological forms from the oldest to the youngest, covering a span of time from at least 600 million years ago to only about the beginning of the Christian era. The specimens have either been collected by ourselves or have been presented to the Institute by numerous colleagues all over the world. Some of them illustrate discoveries of palæobotanical interest, others are of equally great geological significance or have importance in economic geology.

Some of these fossils were discovered only a few weeks ago in the Rajmahal Hills in Bihar. Slumbering for millions of years in the strata, these immortal things woke up, as it were, under the stroke of the geological hammer and again saw the light of day for the first time last January. Now they have been laid to rest again in this stone, as if in a second grave, but with their faces uncovered, undying witnesses of a strange world of the past.

Thus, within the limits of our resources and the technical exigencies, an attempt has been made in this foundation-stone to epitomize the entire field of palæobotanical science to-day, not only in India but in the world. We have been happy also to commemorate here in this way gifts received during the past 30 years or more from colleagues in far-off countries.

It is our hope that in this stone a link will have been forged in the chain of international goodwill and cultural co-operation. By laying this foundation-stone you will therefore be helping us to achieve for this young Institute a hopeful future of broad and truly international outlook which is one of our main objectives.

* Abstracts from the unaltered rough notes of the speech delivered by the late Professor Birbal Sahni, F.R.S., on the occasion of the laying of the foundation-stone of the Institute of Palæobotany, by the Hon'ble Pandit Jawaharlal Nehru, Prime Minister of India and Minister for Scientific Research, on 3rd April 1949.

RURAL ADULT EDUCATION*

WHEN we contrast the demands which democracy makes upon the citizens of a State with the actual condition of education in the different countries of Asia, the picture is one of grave and anxious concern. It is true that in some exceptional cases the problem has been largely mastered. We have Japan which, according to figures available for 1946, has a literacy figure of 95%. Lebanon in the Middle East is also reputed to have a high literacy figure. Turkey has for 1945-46 literacy of 60% in towns and 40% in villages. Philippines with its figure of 52.6% is also comparatively well placed. The same remarks would apply to Ceylon, Thailand, Burma and China. We cannot, however, gauge the magnitude of the problem by percentages alone. China has a literacy figure of over 50%. If we take the total population of China to be 450 millions, this would give an adult population of about 225 millions. It is unlikely that the percentage of literacy will be the same for adults as for children and adolescents. Even if this questionable assumption is granted, the number of adult illiterates in China would be some 125 millions.

If we take the figures for India, we find that in pre-partition India, the total number of literates according to the 1941 census was 37 millions. Assuming that the number of adult literates is about 40% of the total number of literates, this gives a figure a little over 15 millions. This refers only to the pre-partition Indian provinces, but we may put the figures for adult literates after partition at roughly 11 millions. To this we have to add the number of adult literates in the States. This is estimated to be about 6 millions. The number of adult literates in India on the basis of 1941 census is therefore approximately 17 millions against a total adult population of about 180 millions, which gives a literacy percentage for adults slightly less than 10. This is not only unsatisfactory but positively disturbing. Naturally the Government of

India propose to give first priority to a programme of Social Education in its schemes of educational development for the country.

We require in India about a million teachers for dealing with children of school-going age who constitute only about 12½% of the total population. For the adult illiterates who will amount to almost 50% of the population, we would, even on the same basis, require about 4 million teachers.

If we also make allowance for the higher ratio necessary in their case, the number of teachers required may amount to almost 5 millions. Against this, we can, of course, balance the factor that the adult education courses will perhaps last for about 3 months at a time for the first stage of literacy. Even then, the number of teachers to be continually employed on it will be over a million.

To find the million teachers for school children is difficult enough, but if we have to find another million for our programmes of adult education, the problem becomes almost insuperable. But we are considering in India the possibility of utilising the basic school teacher for our programme of Social Education. We are also examining a proposal to use some kind of social conscription by which all educated persons will be required to contribute this national service for a specified period. If all students after matriculation are compelled to teach for even six months, this would, of course, go some way towards helping the solution, but even then the gap to be overcome would be considerable.

There is also the question how far basic school teachers or young collegians will prove suitable for such a programme of National Education. Teaching small children requires in the teacher certain habits and attitudes which he may not be able to shed when addressing adults. Similarly, it is a problem whether young men and women just out of school will have the necessary patience and insight to be successful teachers of adults. It is to be hoped that the different aspects of this intricate question will be carefully gone into and recommendations made so as to be of use to us and other Asian countries.

* Abstract of the Inaugural Address by the Hon'ble Maulana Abul Kalam Azad at Unesco Seminar on Rural Adult Education, Mysore, India, on the 2nd November 1949.

OSCILLATIONS OF THE EARTH'S ATMOSPHERE*

THIS is a new book in the new series. "Cambridge Monographs in Physics". It deals in a concise but comprehensive way with the subject of tides in the atmosphere, an old subject which continues to yield a rich harvest of results of outstanding interest and importance.

The most conspicuous characteristic of the curve of daily variation of barometric pressure in the tropics is its semi-diurnal component with the maxima occurring at about 10 a.m. and 10 p.m. and minima at 4 p.m. and 4 a.m. It was conjectured by Laplace that this 12-hourly variation of the barometer was a tidal effect caused by the heating action of the sun and that the tides due to the gravitational action of the sun and moon were much smaller in amplitude. For a long time, however, it was not clear why the 12-hourly component and not the 24-hourly component was the more prominent. The suggestion was first made by Kelvin that the atmosphere had probably a free period of oscillation with period nearly equal to 12 hours and that the 24-hourly thermal tide-generating force of the sun amplified the 12-hourly free oscillation by resonance.

Further progress has been achieved mainly in this century. Working on Hann's collection of data of solar barometric variation all over the world, Schmidt, Simpson and others have deduced empirical formulæ to represent the variation of the semi-diurnal component over the earth's surface. Chapman and his co-workers have analysed most of the available mass of barometric data for lunar diurnal variation and different components of solar diurnal variation. Lamb showed that the oscillations of an atmosphere in adiabatic equilibrium could be discussed in terms of tidal motions of an ocean of equivalent depth. Taylor extended Lamb's result to an atmosphere with any given temperature distribution and analysing the propagation of air-waves from the Krakatau explosion of 1893 and from the great Siberian Meteor of 1908 showed that the observed velocity of propagation of these long air-waves was consistent with the known

average distribution of temperature in the troposphere and lower stratosphere. Taylor found that the corresponding free period of oscillation of the atmosphere was only about 10 hours and could not explain the amplification of the 12-hourly component of pressure variation. He, however, pointed out that the atmosphere could have not only one free period but a whole series of free periods, depending on the temperature distribution in the atmosphere. The next advance was made by Pekeris who showed that if temperatures in the atmosphere had a maximum of about 350°A at about 60 km. as was required by other lines of evidence, and if this high temperature was succeeded in higher layers by a second region of low temperature, with temperatures of the order of 200°A at 80 km., the atmosphere would have another free period nearly equal to 12 hours. This had been guessed at before by aerologists and has later been confirmed by the V2 rocket experiments in America.

Weekes and Wilkes extended Pekeris' calculations and using the differential analyser of the Mathematical Laboratory at Cambridge, computed the resonance curves of the atmosphere for various assumed temperature distributions. They have also discussed the energy-flow in the atmosphere on the proved analogy of the propagation of tidal waves with that of electro-magnetic waves in an atmosphere of varying refractive index.

All this and much more have been discussed in the first four chapters of the book. In the fifth and concluding chapter, there is a general discussion of the results and of points requiring further elucidation. Tidal motions in the E and F regions of the ionosphere discovered by Appleton and Weekes in England, and by Martyn and co-workers in Australia, their relationships with solar and lunar magnetic variations, the question whether there is still another region of low temperature above a hot E region are some of the points touched on. In the near future we may expect some of these problems to be cleared up.

This little book expounding lucidly and concisely the achievements of classical hydrodynamics in a subject of current interest will doubtless receive a hearty welcome from students of Mathematical Physics and of Geophysics in particular.

K. R. RAMANATHAN.

* *Oscillations of the Earth's Atmosphere*. By M. V. Wilkes. *Cambridge Monographs in Physics*. (Cambridge University Press, Bentley House London, N. W. I.), 1949. Pp. xii + 76. Price 12/6 net.

SIR ARDESHIR DALAL

THE sad and unexpected demise of Sir Ardeshir Dalal on the 8th of last month removes from the Indian scene of science and industry an enlightened, patriotic and farsighted industrialist and a distinguished administrator.

Born on April 24, 1884, Sir Ardeshir Dalal received his early education in the Elphinston College, and studied later at St. John's College, Cambridge. Entering the Indian Civil Service in 1908, he distinguished himself in various capacities before he became Secretary to the Government of Bombay in the Finance Department. He was a member of the Bombay Legislative Council in 1926. In the following year he was called to officiate as Secretary to the Government of India, Department of Education, Health and Lands. In 1928, he returned to Bombay as Collector and Municipal Commissioner.

On retiring from the Commissionership and the I.C.S. in 1931, Sir Ardeshir joined Tatas as a Director. Under his able guidance the Tata Iron and Steel Company grew from strength to strength. Besides being Director of various other Tata concerns, he was also a Director of the Central Bank of India and the Associated Cement Companies.

During the war in 1941, he was invited to act as Liaison Officer in India for the Ministry of Supply and in August 1944, he became a Member of the Viceroy's Executive Council and was placed in charge of the

newly created Department for Planning and Development. Sir Ardeshir was one of the leading sponsors and signatories of the well-known Bombay plan for India's Industrial regeneration. In May 1945, he visited the United Kingdom to discuss problems connected with post-war economic development of India, particularly in the industrial field, and acquainted himself with the situation regarding the availability of capital goods and the training of expert students and technicians. He also visited the U.S.A. to study the possibility of obtaining necessary industrial machinery for factories and mills. In January 1946, he tendered his resignation from the Viceroy's Executive Council for personal reasons. During this short period of his connection with the Government of India, he formulated a plan for the over-seas training of technical personnel; it was in pursuance of this plan, that the Government of India deputed several batches of students for higher training in research and technology in the United Kingdom and the U.S.A. He was knighted in 1946.

Sir Ardeshir was deeply interested in the progress of science in all its aspects; he was to a large extent responsible for inspiring the creation of the Tata Institute for Fundamental Research under the distinguished Directorship of Professor Bhabha. He was closely connected with the progress of the Indian Institute of Science and was elected Chairman of the Court in June 1947.

FIAT REVIEWS OF GERMAN SCIENCE

A FEW months back this office received for distribution one dozen copies each of six titles of the *Fiat Reviews of German Science* for 1939-1946 and offered them to some selected institutions of India and the neighbouring countries of South Asia on the basis of the specialised subjects of their research activities.

It was the intention of the awarding authorities that these volumes should be sent to those who are actually engaged in research on the specialised subjects. Of the remaining titles of these Reviews a recent consignment of 31 titles has just been received at this office. The titles are broadly divided under headings of Physics, Chemistry, Mathematics, Biology and Sciences of the Earth. The number of copies available for distribution is again limited but as there are more of the specialised branches of studies, there may be

opportunities for a wider distribution of the individual titles like Nuclear Physics, Hydro and Aerodynamics, Analytical Chemistry, Chemotherapy, Surgery, Pathology, etc. Interested institutions will kindly help this office by sending their subjects of research mentioning at the same time the directors of research on those special fields. This latter information will be helpful to the office in future for locating the active centres for contact with outside world. It is likely that some institutions have already got all *Fiat* volumes from governmental source and such institutions may kindly inform this office in order to keep a list of sources of the availability of *Fiat Reviews* and eventually to direct the enquirers nearer those sources.—[By courtesy of UNESCO Office of South East Asia, Delhi.]

LETTERS TO THE EDITOR

	PAGE		PAGE
<i>On the Photo-Sensitivity of Neon Lamps and their Use in Cosmic-Ray Circuits—OM PARKASH</i>	400	<i>Hormone Induced Set and Parthenocarpy in Mango (Mangifera indica L.)—L. VENKATARATNAM</i>	409
<i>On a Stellate Discocycline from the Upper Eocene of Surat-Broach Area (Bombay Presidency)—B. S. TEWARI</i> ..	401	<i>Protogyny in Indian Forms of Saccharum spontaneum—SUNIL KUMAR MUKHERJEE</i>	410
<i>Germination of Double Grained Paddy in Relation to the Anatomy of Lemna and Palea—G. V. CHALAM</i>	401	<i>On the Chromosomes of a Cricket, Lio-gryllus Bimaculatus—M. K. DUTT</i> ..	411
<i>Vanadimetry—Part V. Volumetric Estimation of Uranium with Sodium Vanadate—M. NARASIMHASASTRI AND G. GOPALA RAO</i>	402	<i>Necrosis in Tomato (Lycopersicum esculentum Mill.)—R. S. VASUDEVA, R. P. GARGA AND R. N. AZAD</i>	411
<i>Dielectric Constants of Cashew Shell Oil—B. R. Y. IYENGAR AND S. KRISHNAMURTHY</i>	403	<i>Photoperiodic Response in Some X-Ray Mutant Wheats—GADADHAR MISRA</i> ..	413
<i>The Temperature of Zero Conductance of Certain Dyestuffs—SATYA PRAKASH AND TEJ NARAIN SHIVAPURI</i>	403	<i>Effect of Vernalization and Photoperiodic Treatments on Grain Development in Wheat—J. J. CHINYOY</i>	414
<i>Occurrence of D-Mannitol in the Exudation of Olea glandulifera—J. SRI RAM AND P. L. NARASIMHA RAO</i>	404	<i>Proliferation of Grass Spikelets—T. J. JENKIN</i>	414
<i>A Synthesis of Prunetin—R. N. IYER, K. H. SHAH AND K. VENKATARAMAN</i> ..	404	<i>Occurrence of Turions in Elodea canadensis—K. M. SAFEULLA AND H. C. GOVINDU</i>	414
<i>Manufacture of Taurine—M. V. VAKILWALLA AND D. M. TRIVEDI</i>	406	<i>On the Nectary in the Stamens of Memecylon heyneanum Benth.—K. SUBRAMANYAM</i>	415
<i>Effect of Streptomycin on Glycerine Vaccine Lymph (Calf Lymph)—V. N. KRISHNAMURTHY</i>	406	<i>Cicindelids from Krusadai Island and Kutikal Point in the Gulf of Mannar—J. SAMUEL RAJ AND K. V. VERGHESE</i> ..	416
<i>Some Observations on the Biology of Tetrastichus hagenowii, Ratz.—An Egg Parasite of the House-Cockroach (Periplaneta americana, L.)—SYED USMAN</i> ..	407	<i>A Possible Explanation of the Joshi Effect—SAIYID SHAMIM-AHMAD AND M. V. RAMANAMURTI</i>	416
<i>Microbracon hebetor S., and Stenachroia elongella H.—M. APPANNA</i>	408	<i>Artificial Infection of Sorghum with Long Smut—T. S. RAMAKRISHNAN AND G. S. REDDY</i>	418
<i>Chromosome Numbers in Indian Economic Plants—III. S. SAMPATH AND K. RAMANATHAN</i>	408	<i>Ultra-Violet Absorption Spectrum of Iodobenzene—K. SREERAMAMURTY AND K. R. RAO</i>	418

ON THE PHOTO-SENSITIVITY OF NEON LAMPS AND THEIR USE IN COSMIC-RAY CIRCUITS

OBSERVATIONS of the author and Sarna¹ have shown that neon lamps exhibit a kind of photo-sensitivity, and that this affects the performance of cosmic-ray circuits employing such lamps. Yeater² met the difficulty by putting some extra lamps to produce continuous diffused illumination.

To test this fact, three lamps were exposed to different types of light in front of a 250-watt Phillips mercury lamp. The various voltages were measured by a 'Weston Analyzer' of resistance 20,000 ohms/volt. The results are shown in Table I.

TABLE I

		FLASHING VOLTAGE WITH				
LAMPS		Stray Light	Direct Illumination	Blue Filter	Green Filter	Yellow Filter
		volts	volts	volts	volts	volts
1	G.E.C. NE-17	70	60	65	70	70
2	G.E.C. NE-2	67.5	60	62.5	67.5	67.5
3	G.E.C. E5541-A-F-36 (Argon)	90	87.5	90	90	90

It is clear from the above that the flashing voltage is lowered when the neon lamps are under illumination, more so with blue light. It was further observed that once

the lamps started glowing there was no effect of light on the current flowing or on the voltage across the lamp.

In view of the above, the use of neon lamps should be avoided in such circuits, or if used, the lamps must be painted red so that they become immune to light effect.

The author is grateful to Mr. B Bhowmik of the Delhi University Physics Department, Delhi, for providing facilities for this work and Messrs. Jugal Kishore, M.Sc. (D. U.) and S. K. Suri, M.Sc. (N. P. L.), for helping and lending the apparatus needed.

East Punjab University, OM PARKASH.
Physics Department,
Government College,
Hoshiarpur,
October 17, 1949.

1. Parkash, Om, and Sarna, H. R., *Ind. Jour. Phys.*, 1948, 22, 19. 2. Yeater, Max, L., *Phys. Rev.*, 1945, 67, 74.

ON A STELLATE DISCOCYCLINE FROM THE UPPER EOCENE OF SURAT-BROACH AREA (BOMBAY PRESIDENCY)

STELLATE discocyclines are important in the zonal classification of the Eocene beds; and from India and neighbouring regions the following are known:

1. *Orbitoides asterifera*—Described by Carter¹ from the Laki horizon of the Kelat-valley in Baluchistan. Only the external characters are known and from Carter's description it appears to be an *Asterocyclina*.

2. *Actinocyclina alticostata*—Described by Nuttall² from the Middle Kirthar horizon of Kutch.



Actinocyclina cf. *crassicostata* Douville' $\times 5\frac{1}{2}$.
Upper Eocene of Bhodan, near Surat.

3. *Pseudophragmina* (*Asterophragmina*) *pagoda*—Described by S. R. N. Rao³ from the Yaw stage (Priabonian) of Burma.

The stellate discocycline now being recorded was collected by the author from the *Pellatispira*-bed of the Surat-Broach area to which an Upper Eocene age has been assigned.^{4, 5} The fossil has a discoidal test with a mamelon in the centre. In complete specimens radial ridges do not extend beyond the periphery of the test. The specimen figured is 6.3 mm. in diameter. An axial section shows that the radial ridges are built by lateral chambers as in the genus *Actinocyclina* as now defined by Brönnimann.⁶ The fossil is unlike any discocycline so far described from India, and appears to be very close to, if not, identical with *Actinocyclina crassicostata* which Douville⁷ has described from the Priabonian (Upper Eocene) of France.

I am indebted to Prof. S. R. Narayana Rao, for his guidance.

Dept. of Geology, B. S. TEWARI.
University of Lucknow,
Lucknow,
September 17, 1949.

1. Carter, *Journ. Bomb. Br. Roy. Asiat. Soc.*, 1861, 6, 78-79. 2. Nuttall, *Rec. Geol. Surv. Ind.*, 1926, 59, 151. 3. Rao, S. R. N., *Rec. Geol. Surv. Ind.*, 1942, Prof. Paper 12. 4. —, *Journ. Mys. Univ.*, 1941, 2. 5. —, *Proc. Nat. Acad. Sci.*, 1944, 14. 6. Brönnimann, *Eclog. Geol. Helvet.*, 1945, 38, 574. 7. Douville', *Bull. Soc. Geol. Fr.*, 1922, 22.

GERMINATION OF DOUBLE GRAINED PADDY IN RELATION TO THE ANATOMY OF LEMMA AND PALEA

In the germination of double grained paddy a peculiarity was observed. Embryos in the primary and secondary kernels are located facing the lemma and palea respectively. When the double grained paddy seeds are kept for germination, only the embryo facing lemma germinates, while one facing the palea does not. It was suspected that the embryo facing the palea may not be viable. Naked primary and the secondary kernels were taken out of the pericarp and put to germination test. It was found that the embryos in both the kernels germinated, but the embryo in the secondary kernel grew less vigorously. The mechanical obstruction of the palea apparently prevented the germination. In the embryo in the secondary kernel of order to confirm the same, anatomy of both

lemma and palea was studied in serial sections.

Structure of the lemma at the basal end, where the embryo is located, is quite different from the other portions of the same. Throughout its length (5 to 8 mm.) the hypodermal cells under the midrib are not lignified. These cells are small in size and thinwalled. Absence of lignified hypodermal tissue gives the appearance of a slit at this portion. Epidermal cells also are small in size compared to the neighbouring epidermal cells. Further the epidermal cells at other portions are corrugated with incrustation of silica on both sides while at this place they are smooth-walled and devoid of any incrustation of silica or trichomes (Fig. 1).

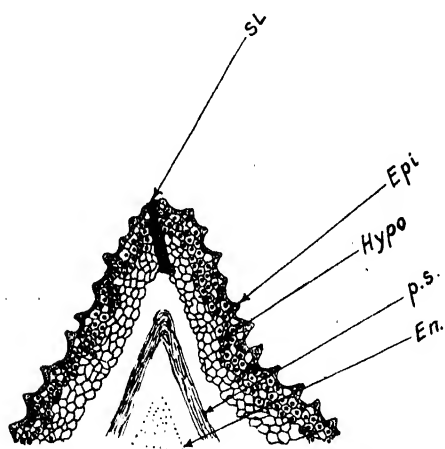


FIG. 1. T. S. of lemma at the basal portion

Epi—Epidermis. *Hypo*—Hypodermis *SL*—Slit—like portion of the lemma where the cells of the hypodermis are not lignified through which embryo emerges. *p. s.*—perisperm. *En*—Endosperm.

In the structure of the palea the outer epidermal cells exhibit similar lignifications and silicifications as those found in the lemma. The epidermal cells are slightly smaller in size in general and particularly they are very much reduced where the palea is clasped by the margins of lemma. The hypodermal cells are thickened and lignified. The structural peculiarity found in the case of lemma near the embryo is not found here. There are no rows of thin-walled cells below the midrib as found in the case of lemma.

During germination the pericarp is pushed through by the coleorhiza leaving a cavity

in front of the rootcap. Primary root soon elongates and fills the cavity. On further growth the root extends upwards in the direction of epicotyl for a short distance before it responds positively to the stimulus of gravity. About this time the coleoptile also emerges splitting open the lemma at the particular portion described above. In the case of palea the lignified hypodermal tissue offers mechanical resistance for the growth of the embryo in the secondary kernel which is also less vigorous than the primary embryo. Consequently there is no germination.

To establish mechanical obstruction of the palea over the embryo in the secondary kernel, half the palea was finely scalpeled when the embryo in the secondary kernel germinated behind the embryo in the primary kernel.

The author's thanks are due to Dr. P. K. Parija and Mr. K. Ramiah for their valuable suggestions and assistance.

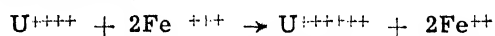
G. V. CHALAM.

Land Reclamation Scheme,
Damodarpur,
P. O. Sukinda,
Cuttack (Orissa),
September 9, 1949.

VANADAMETRY—PART V

Volumetric Estimation of Uranium with Sodium Vanadate

THE present communication deals with the determination of U^{+++} with sodium vanadate as a reagent. A known volume of a 0.05 N solution of uranyl sulphate was reduced in a Jones Reducter according to the directions given by Lundell and Knowles and later treated with a stream of purified air for five minutes. The titration of the resulting U^{+++} solution with a standard solution of sodium vanadate was not found feasible, when diphenyl benzidine was used as indicator, because of the extremely slow development of the colour of the indicator. The difficulty is overcome by adding ferric alum solution in excess of that required for the reaction.



We have tried another and a novel way of overcoming the difficulty of the slowness of the end point in the titration of U^{+++} with sodium vanadate. Our experiments have shown that an overall concentration of 0.01 N oxalic acid is enough to catalyse the

sharp development of the indicator colour by a drop of 0.05 N vanadate solution at a temperature of 50°. In the following

TABLE I

Reduced uranium solution + excess Fe^{+++} + 5.0 ml. of phosphoric acid (1.75 sp. gravity) + 1.0 ml. of 0.1% diphenyl benzidine. Total volume of solution 300 ml. (overall concentration of sulphuric acid above 1.0 N).

Milli equivalents of uranium	
Dichromate method	Vanadate method
0.5095	0.5120
0.4076	0.4076
0.2540	0.2540
0.2038	0.2036

experiments, the U^{+++} solution was rapidly brought to 50° C. in two to three minutes after addition of 3.0 ml. of 1.0 N oxalic acid and 1.0 ml. of diphenyl benzidine and then quickly titrated with standard sodium vanadate solution to a blue violet colour. The results recorded in Table II show that this direct method also gives accurate results.

TABLE II

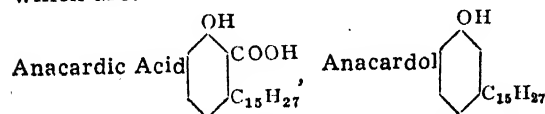
Amount of uranium found (in milli equivalents)

Ceric sulphate method	Vanadate method
0.9370	0.9340
0.4298	0.4303
0.3016	0.3009
0.7013	0.7030
0.3562	0.3557
0.6350	0.6046

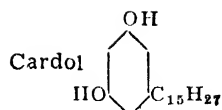
Andhra University, M. NARASIMHASASTRI.
Waltair, G. GOPALA RAO.
August 25, 1949.

DIELECTRIC CONSTANTS OF CASHEW SHELL OIL

The dielectric constants of commercial cashew shell oil, the main constituents of which are:—



(formed by the decarboxylation of anacardic acid during the initial heat treatment of the raw oil) and



have been studied. The investigations conducted on six commercial samples from various sources of different compositions reveal:—

(1) Cashew shell oil can be distinguished from coconut, linseed, olive, poppy seed, perilla, rape seed, sesame and tung oils (dielectric constants ranging from 3.0 to 3.6¹⁻⁵ at room temperature and audio frequency), by its decidedly higher dielectric constant (4.6). Castor oil has nearly the same dielectric constant as cashew shell oil.

(2) The dielectric constant of the bicarbonate soluble constituent increases continuously with temperature between 30 to 100° C. The neutrals which form a small portion of the oil have a low dielectric constant with a negative temperature coefficient. Temperature variation of the dielectric constant of the oils and their respective bicarbonate insolubles differs considerably. This is attributed to viscosity effects due to self-polymerized products and to the different proportions of anacardol in the two cases.

Complete experimental details are being published elsewhere.

Gen. Chem. Labs., B. R. Y. IYENGAR.
Ind. Inst. of Science, S. KRISHNAMURTHY.
Bangalore 3,
October 4, 1949.

1. Bhattacharya, *Ind. Jour. Phys.*, 1936, 10, 290. 2. Caldwell and Payne, *Ind. Eng. Chem.*, 1941, 33, 954. 3. Hazellhurst, *Paint Manfr.*, 1943, 13, 273. 4. Paranjpe and Deshpande, *Proc. Ind. Acad. Sci.*, 1935, A-1, 880. 5. Stoops, *Jour. Phys. Chem.*, 1931, 35, 1704.

THE TEMPERATURE OF ZERO CONDUCTANCE OF CERTAIN DYESTUFFS

KOHLRAUSCH AND GROTRIAN explained the temperature effect on the conductivity of electrolytes by the following equation:

$X_t = X_0 [1 + c(t - t_0) + c'(t - t_0)^2]$
 $t_0 = 0^\circ \text{ or } 18^\circ \text{C.}$, c being always positive, whereas c' may for some substances become negative.

Using Kohlrausch's data, the equation
 $X_t = X_{18} [1 + c(t - 18) - c'(t - 18)^2]$

is generally found to hold good for aqueous solutions between 0° and $35^{\circ}\text{C}.$, where $c' = 0.0163(c - 0.0174)$. In some cases, c' equals to $0.0177(c - 0.0177)$. Substituting these values in the above equation, we obtain $X_t = X_{18} [1 + c(t - 18) + 0.0177(c - 0.0177)(t - 18)^2]$. Hence the value of $X_t = 0$ when $t = -38.5^{\circ}\text{C}.$, i.e., the conductivity vanishes for aqueous solutions below $-39^{\circ}\text{C}.$

Studying the temperature of zero conductance for jelly-forming salts of thorium, Prakash¹ and recently Mushran and Prakash² have determined its value for various negatively charged colloidal systems. Nine out of twelve substances studied by them attain zero conductance between -20° to $-30^{\circ}\text{C}.$; that of dyestuffs investigated by us also fall in the same range.

Dyes*	Zero conductance temperature	
Methylene Blue	..	- 22.5
Fuchsin	..	- 22.0
Aniline Blue	..	- 21.0
Indigo Carmine	..	- 22.0
Bordeaux B	..	- 22.5
Benzopurpurin	..	- 21.5
Congo Red	..	- 21.5
Aniline Brown	..	- 22.5
Methyl Orange	..	- 22.5
Dianilazurin G	..	- 23.5
Aniline Scarlet	..	- 23.0

* Each in 3 concentrations .05, .10, .20 per cent.

Water-soluble dyestuffs are the sodium or potassium salts of dye-forming acids of high molecular weight, or hydrochlorides or sulphates of a dye-base, and consist of: (a) ordinary inorganic ions of high mobility; (b) a micelle of high molecular weight and low mobility. The former's reaction to temperature will be similar to that of ordinary electrolytes, while the latter will attain zero conductance much earlier when the temperature is lowered. Another contributory factor which is significant in such cases is the association of water molecules, which increases rapidly on lowering the temperature.

Hence it follows that for solutions containing colloidal micelle, the temperature of zero conductance is higher than for ordinary electrolytes. Such would seem to be the case for soaps, dyestuffs, albuminous

substances, tannins, etc., and for inorganic colloids.

SATYA PRAKASH.

TEJ NARAIN SHIVAPURI.

The Chem. Labs.,
University of Allahabad,
August 29, 1949.

1. *Jour. Phys. Chem.*, 1933, 37, 907. 2. *Ibid.*, 1946, 50, 251.

OCCURRENCE OF D-MANNITOL IN THE EXUDATION OF *OLEA GLANDULIFERA*

A manna-like substance, an exudation from *Olea glandulifera* ("Sugar tree") in the Aiyur forest is reported to appear during draught and is considered to be caused by incisions wrought by insects. Any artificial injury to the tree failed to induce the exudation.

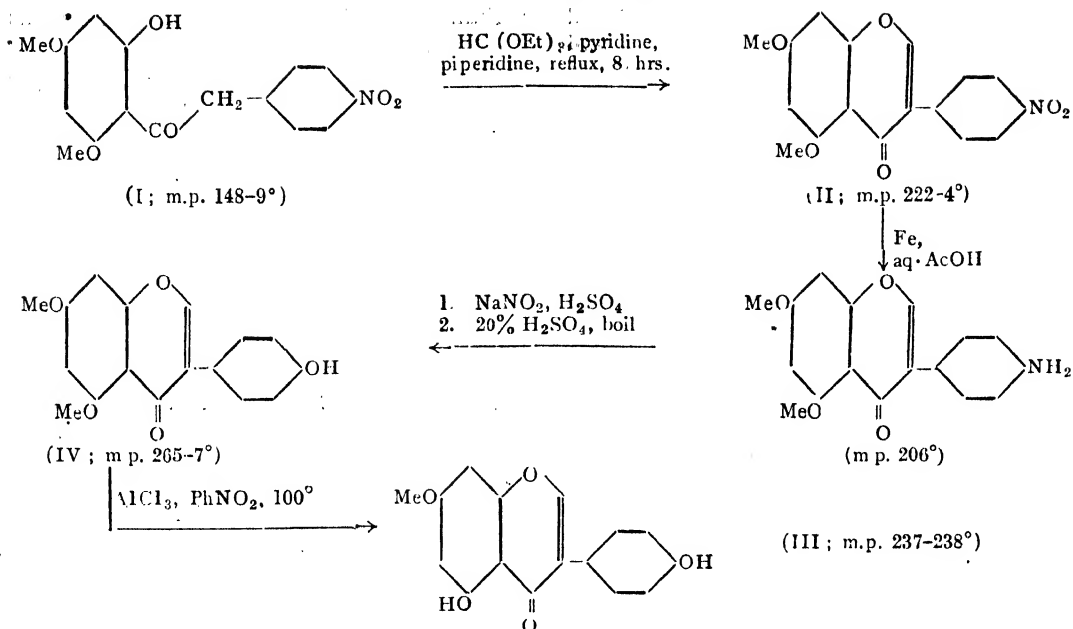
A sample of this pale yellow exudation, collected in 1946, was found after the removal of fibrous material (Ca 5%) to dissolve freely in hot water. It is practically free of ash, and contains only traces of gelatinous matter and reducing sugars. The aqueous solution, on concentration and chilling or by addition of absolute alcohol (3 vols.) after a clarifying treatment with charcoal, deposited pure crystals of D-mannitol, m.p. $165-6^{\circ}$ (identified by mixed m.p. with an authentic sample, by optical rotation before and after addition of borax and by the preparation of mannite-tribenzacetol,¹ m.p. 207°) in about 95 per cent. yield on the basis of water-soluble solids.

Dept. of Biochem., J. SRI RAM.
Ind. Inst. of Sci., P. L. NARASIMHA RAO.
Bangalore,
October 31, 1949.

1. *Identification of Pure Organic Compounds* by S. P. Mulliken, Vol. I, p. 155.

A SYNTHESIS OF PRUNETIN

THE action of ethyl orthoformate on 2-hydroxy-4:6-dimethoxyphenyl 4-nitrobenzyl ketone (I) in boiling pyridine containing a little piperidine yields 5:7-dimethoxy-4'-nitroisoflavone (II) in 60% yield. Prunetin (III) has been synthesized from (I) by



the indicated series of reactions. Preferential demethylation of the 5-methoxyl group in (IV) can be effected by means of aluminium chloride in nitrobenzene or hydrobromic acid in acetic acid. Such partial demethylation of the 5- and 3-methoxyl groups in the flavone series, first observed by Bharadwaj¹ and Mahal,² and since used for the synthesis of several naturally occurring, partially *O*-methylated flavones and flavonols, has now proved to be of value also in the isoflavone group. The isoflavone (IV) is a suitable intermediate for santal, recently shown to be 5:3':4'-trihydroxy-7-methoxyisoflavone.³ The synthesis of santal is in progress. Using the method of Joshi and one of us,⁴ Robertson, Suckling and Whalley have synthesized santal trimethyl and triethyl ethers.³

Späth and Lederer synthesized the naturally occurring isoflavones, daidzein and pseudobaptigenin, by condensing the appropriate *o*-hydroxyphenyl benzyl ketone with ethyl formate and sodium at 100° in a sealed tube, treating the product with boiling alcoholic hydrochloric acid, and purifying the isoflavones by high vacuum sublimation.⁵ The condensation of *o*-hydroxyphenyl benzyl ketones with ethyl formate and sodium usually proceeds smoothly at 0° to yield the isoflavone in one stage; but the reaction fails with (I). While Joshi and Venkataraman protected hydroxyl groups other than the 2-hydroxyl,

Shriner and Hull have found that this is not necessary in the synthesis of 5:7-dihydroxy-4'-methoxyisoflavone (biochanin A) and 5:7:4'-trihydroxy-8-methylisoflavone (8-methylgenistein).⁶ We have observed that the reaction may be carried out without protection of the 4-hydroxyl in 2:4-dihydroxyphenyl benzyl ketone, although the 4-benzyl ether gives a better yield; but we have encountered difficulties in the preparation of 5:7-dihydroxyisoflavone directly from 2:4:6-trihydroxyphenyl benzyl ketone. However, 2-hydroxy-4:6-dimethoxyphenyl benzyl ketone (m.p. 116°) condenses readily with ethyl formate and sodium to 5:7-dimethoxyisoflavone (m.p. 120°), and demethylation with hydriodic acid gives 5:7-dihydroxyisoflavone, m.p. 193-194°; partial demethylation with hydrobromic acid in acetic anhydride gives 5-hydroxy-7-methoxyisoflavone, m.p. 139-140°.

Details will shortly appear in the *Proceedings of the Indian Academy of Sciences*.

Dept. of Chem.

R. N. IYER.

Technology,

K. H. SHAH.

The University,

K. VENKATARAMAN.

Bombay,

October 12, 1949.

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Venkataraman, *ibid.*, 1934, 513; Mahal, Rai and Venkataraman, *ibid.*, 1120, 1769. 5. Späth and Lederer, *Ber.*, 1930, 63, 745. 6. Shriner and Hull, *J. Org. Chem.*, 1945, 10, 228, 288.

MANUFACTURE OF TAURINE

ALTHOUGH several processes exist for synthesising taurine, the method by which it could be made cheaply on a commercial scale was published recently by Goldberg¹ who reacted β -amino ethyl sulphuric acid with sodium sulphite with or without pressure to obtain a 70 per cent. yield of pure taurine. β -Amino ethyl sulphuric acid can be made in quantitative yields by sulphonation of ethanolamine after the method of Rollins and Calderwood².

The commercial process³ for the manufacture of taurine as worked by Messrs. I. G. Farben Industries, Germany, consists in the reaction of hydroxyethane sodium sulphonate with NH_3 at 200 atmosphere pressure and a temperature of 280°C . under nitrogen cushion. The hydroxy ethane sodium sulphonate is obtained by them by reacting a solution of sodium bisulphite with ethylene oxide also under inert atmosphere. These methods, as can be seen, are very difficult under present conditions in India.

The difficulty in Goldgerg's method is the separation of pure taurine from the reaction mass. The method employed is not only expensive but involves severe corrosive conditions.

This method is now modified by us with a view to making it attractive for commercial production.* β -Amino ethyl sulphuric acid (1 mol.) is boiled with sodium sulphite (1.1 mol.) for about 48 hours when the reaction is complete. The solution contains taurine together with sodium sulphate which is formed as a by-product. The boiling solution is then treated with a solution of calcium chloride (25% solution) taking care that no excess is added. Calcium sulphate which is formed settles rapidly. It is filtered and the resulting solution is concentrated to remove sodium chloride. Due to low solubility of sodium chloride, most of it is precipitated. The solution is filtered and then cooled in ice when crystal taurine crystallises, yield 80 per cent. of theory. The resulting solution contains probably ditaurine as a yellow waxy mass. Igepons as marketed by I. G. Farben Industry contains

sodium sulphate and sodium chloride as diluents.

For β -amino ethyl sulphuric acid we used a product marketed by B. F. Goodrich Co., Inc. Cleveland, Ohio, U.S.A., under the name of Goodrite β -amino ethyl sulphuric acid. It is available as white crystalline solid of 98 per cent. purity at a price ranging around 45 cents f.o.b.

The Kesar Sugar Works Ltd.,
Chemical Division, M. V. VAKILWALLA.
Goregaon, B. S. D., D. M. TRIVEDI.
August 23, 1949.

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* Between 2000-3000 tons of Igepons are imported at present annually and used in India in the making of paper, textiles, etc.

EFFECT OF STREPTOMYCIN ON GLYCERINE VACCINE LYMPH (CALF LYMPH)

CONTRARY to the views held by some workers,^{1,2} penicillin is ineffective³ in reducing microbiological contaminants of vaccine lymph.

Preliminary sterility tests on streptomycin-treated lymph after its removal revealed that a concentration of 5 mg. per ml of streptomycin was necessary to destroy the staphylococcus group of organisms from the vaccine lymph. The staphylococcal population, about 252 millions per ml. of vaccine lymph before treatment, was reduced to a mere 240 per ml. within 24 hours contact in cold storage (-10°C) with streptomycin in 5 mg. concentration and to 40 per ml., in another week's time. A few of the *B. subtilis* group remained unaffected by streptomycin even in higher concentrations, possibly because of their existence as spores. In combination with 500 units of penicillin, as little as 500μ gm. of streptomycin per ml., of vaccine lymph gave almost the same result. Bigger,⁴ Chain & Duthie,⁵ Himmelweit⁶ and Pulaski, *et. al.*⁷ find that certain antibiotics in combination with sulphanamides, bacteriophages or antibiotics produce such a synergistic action.

The potency of vaccine lymph is unaffected both by streptomycin and penicillin in contrast to chloroform which lowers the potency.

This is a finding of considerable practical significance and will not only lead to the preparation of a purer lymph but also contribute towards a substantial lowering in the costs of production.

Vaccine Institute, V. N. KRISHNAMURTHY,
Bangalore City,
October 17, 1949.

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**SOME OBSERVATIONS ON THE
BIOLOGY OF *TETRASTICHUS
HAGENOWII*, RATZ.—AN EGG
PARASITE OF THE HOUSE-
COCKROACH (*PERIPLANETA
AMERICANA*, L.)**

Tetrastichus hagenowii, Ratz. (Hymenoptera, Eulophidæ), is an egg-parasite in oothecæ of the cockroach, first observed in 1932; it has been bred here from the egg-capsules of the three common species *Periplaneta americana*, L., *P. australis*, F., and *Blatta orientalis*, L.

All the pre-adult stages of the parasite are passed well-protected within the egg-capsule of the cockroach. Eggs are laid by the female parasite inside the host eggs within the oothecæ. When freshly laid, the egg is smooth, shining and transparent; it is elongate-oval, with the caudal end narrow and somewhat curved; prior to hatching it becomes clouded and assumes a pale yellow colour. The newly hatched larva is smooth, flat and transparent and its segments fairly well defined; the fully grown larva (2.7 to 3.2 mm.) is white, tapering towards extremities, with abdominal segments opaque and dark brown owing to food contents inside; tracheal system well defined. Pupa (1.6 to 2.1 mm.) at first is white with eyes, mouth appendages, leg and wing rudiments clearly defined, later on changes to deep brown in course of chitinisation; the female pupa is bigger than the male pupa.

The period of development of the parasite from egg to adult averaged 23.6 days in October-November 1948, about 6 to 9 days

shorter than the incubation period of the egg of the cockroach (*Periplaneta americana*) at this season.

Period of observation: 26th October to 24th November 1948.

Period of development: 22 to 26 days \pm 6 hrs.

Temperature: Mean—73.2°F.; Maximum—84.8°F.; Minimum—62.3°F.

Emergence of the Parasites.—The number of parasites emerging from a host egg-capsule varied from 7 to 48, the average being 32.7. The ratio of females to males was invariably 3:1. Adult parasites escaped by biting holes (1 to 3) in the host egg-capsules, the presence of these emergence holes being the only external symptom of the parasitisation of the host egg-capsules. Emergence of the parasites generally took place in the mornings, and the parasites from one and the same host egg-capsule emerged on the same day. Soon after emergence, they became active, fed on dilute honey and copulated. Several female parasites were fertilised by the one male. The female parasites lived on an average 12.5 days when fed on dilute honey, and 7.8 days without food, the male only 3.4 days.

Natural incidence.—The incidence of the parasites was studied from host egg-capsules collected at random in Bangalore periodically.

*Percentage of natural parasitisation of the egg-capsules of *Periplaneta americana*, L., by *Tetrastichus hagenowii*, Ratz.*

Period	No. of cockroach egg-capsules		Percentage of parasitisation
	Examined	Parasitised	
July 1947–June 1948	495	102	20.6
July–Dec. 1948	288	123	42.7
July–Oct. 1949	178	103	56.7

The parasites were in abundance and most active during the period from September to November; when they parasitised 43.0 to 62.2 per cent. of the host egg-capsules. August to October is also the main egg-laying season of the host cockroach. It was observed that from a number of parasitised host egg-capsules the parasites did not emerge; this appeared to be due to two causes: (i) overpopulation of the developing parasites in the eggcapsule, which stifled their complete

development; and (ii) pre-adult parasites in normal numbers dead on account of excessive dry condition of the host egg; in such cases normal emergence of parasites was secured by sprinkling a small quantity of water on the host egg-capsules at intervals of 3-4 days.

I am thankful to Sri. B. Krishnamurti, Government Entomologist, for encouragement and guidance.

Entomological Laboratory, SYED USMAN.
Agric. Res. Institute,
Bangalore,
November 4, 1949.

MICROBRACON HEBETOR S., AND STENACHROIA ELONGELLA H.

OUR observations have revealed that *Microbracon hebetor* S.—the common Braconid larval parasite of the rice and flour moth—*Corcyra cephalonica* St.—shows marked preference to the caterpillar of *Stenachroia elongella* H., a field pest of jola (Jowar) earhead in Mysore. (*Microbracon hebetor* S. has also been previously recorded in Mysore, as preferring another field pest, namely, *Adisura atkinsoni* M.—Lab-lab pod-borer.^{1,2})

As in the case of *Corcyra cephalonica* St. and *Adisura atkinsoni* M. larvæ, this webbing caterpillar, *Stenachroia elongella* H., is also paralysed by *Microbracon hebetor* S., prior to egg deposition. But unlike in the former two cases, where eggs are deposited on the dorsul, lateral (intersegmental) and ventral surfaces of the host-body, the eggs are invariably deposited on the ventral surface of the caterpillar of *Stenachroia elongella* H. Caterpillars of the third instar and onwards upto the prepupal stage are successfully attacked.

Detached caterpillars of *Stenachroia elongella* H., as well as those *in situ* in the jola earhead, are found attacked by *Microbracon hebetor* S. in the laboratory. Field tests are being planned.

I am thankful to Sri. B. Krishnamurti, Government Entomologist, for encouragement and guidance.

Entomological Laboratory, M. APPANNA.
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Bangalore,
November 4, 1949.

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CHROMOSOME NUMBERS IN INDIAN ECONOMIC PLANTS—III

THE cytology of Indian economic plants is being studied on an increasing scale in the various laboratories.¹ In this connection the following list of chromosome numbers counted in some plants are reported. After reference to the Chromosome Atlas² and to the recent publications, these are reported as first record for these plants. The list is meant to avoid duplication of work. Incidentally it brings out the prevalence of regularity in chromosome numbers in allied genera and species. It also brings out the part played by polyploidy in angiosperm evolution. Columns four and five give as positive or negative, whether the observed number tallies with recorded numbers in related species, and whether it forms a member in the polyploid series in the plant groups, as classified in the Chromosome Atlas, cited above.

A full discussion of these aspects cannot of course be taken up at the present stage. A few comments on special features are however given.

Serial number	Name of plant	2n number	Regularity in group	Polyploid series
MIMOSACEÆ				
1	<i>Prosopis juliflora</i> DC.	52	+	+
2	<i>Parkia biglandulosa</i> W. & A.	26	+	+
3	<i>Leucaena glauca</i> Benth.	c. 104	+	+
4	<i>Pithecolobium dulce</i> Benth.	26	+	+
PAPILIONACEÆ				
5	<i>Indigofera dosua</i> Hamilt.	16	+	+
6	<i>Gliricidia maculata</i> Benth.	20	+	+
7	<i>Mucuna pruriens</i> DC.	22	*	*
8	<i>Cassia glauca</i> Lamk.	28	+	+
9	<i>Cassia angustifolia</i> Vahl.	28	+	+
10	<i>Cassia hirsuta</i> Linn.	56	+	+
11	<i>Casipoupermum australe</i> A. Cunn.	26	-	-
PEDALINEÆ				
12	<i>Sesamum occidentale</i> Heer & Regel	64	+	+
GRAMINEÆ				
13	<i>Eremopogon foveolatus</i> Stapf.	40	+	+
14	<i>Andropogon pumilus</i> Roxb.	20	+	+
15	<i>Amphilophis pertusa</i> Stapf.	40	+	+
16	<i>Cynodon plectostachyum</i> Pilgr.	18	+	+
17	<i>Setaria nervosum</i> Stapf.	34	-	-
18	<i>Oryza australiensis</i> Domin.	24	+	+
19	<i>Oryza stapfii</i> Roshev.	24	+	+
20	<i>Oryza latifolia</i> (?)	48	+	+

The numbers have been counted in sections of actively growing root tips. The maximum possible number obtained from different intact cells are given. One source

of error is the prevalence of polyploid cells in roots of legumes, and necessary caution has been used. In *Castanospermum* (11) an Australian genus, the $2n$ number does not fit in with that of related genera of other continents, and further studies are necessary. In many grasses, ecotypes show chromosome diversity. The number found in *Sehima* (17) may not be the same in other types and species. In view of this type of variability, other fodder grasses, *Panicum antidotale* Retz., *Brachiaria mutica* Stapf., *Cenchrus ciliaris* Linn. and *Dicanthium annulatum* Stapf. were studied cytologically and numbers tallying with record were counted. In the grass *Eremopogon foveolatus* (13) the $2n$ number was 40 and not 45, both numbers having been recorded. In the genus *Mucuna* (7, Syn. *Stizolobium*) other species have to be studied to see if the count made, tallies. In the wild sesamums, a new species *Sesamum occidentale* (12) was procured from Ceylon and grown. The number was counted in root tips as well as pollen mother cells and is a tetraploid compared to *S. laciniatum* and *S. prostratum*.

In the important genus *Oryza*, two species *O. australiensis* (18) and *O. Stapfi* (19) were imported and grown for cytogenetical studies. About the species *O. latifolia* (20) there is some doubt. This was identified as *O. latifolia* Desv. but is not *O. latifolia* of Hooker and was obtained from Tropical America. It seeds freely and seedlings have the number $2n=48$ and not 24 as recorded previously.

We are indebted to many members of the Agricultural Department, for help in all stages in this work.

Cytogenetics Laboratory, S. SAMPATH.
Agric. Res. Institute, K. RAMANATHAN.
Coimbatore,
October 19, 1949.

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HORMONE INDUCED SET AND PARTHENO-CARPY IN MANGO (*MANGIFERA INDICA* L.)

In mango inflorescence ranging from 2000 to 6000 flowers, hardly 1% reach maturity; the rest are either males or drop off before setting. According to Bijhouwer,¹ Naik² and Mukherjee³ nearly two-thirds of the bisexual flowers are not pollinated; hence the low fruitage in mango.

To investigate the effect of β -naphthoxyacetic acid on mango fruit set, mature buds were selected in *Neelum*, *Bangalore* and *Banganapalle*, three reputed South Indian varieties. The staminate flowers were nipped off and only 20 to 30 bisexual flowers were retained in an inflorescence after emasculating the single stamen. The emasculated flowers were sprayed with water containing 10 p. p. m. of β -naphthoxyacetic acid and were immediately covered with cellophane paper to prevent pollination. A fortnight later, when fruit set was noticed, the covers were removed. The percentage of flowers developing were 26.0, 18.4 and 2.3 per cent. for *Neelum*, *Bangalore* and *Banganapalle* respectively, as against 12.3, 6.9 and 1.3 obtained normally. After reaching marble size the flowers dropped off due to external disturbances.

The fruits on examination showed parthenocarpic development (*vide* photograph).

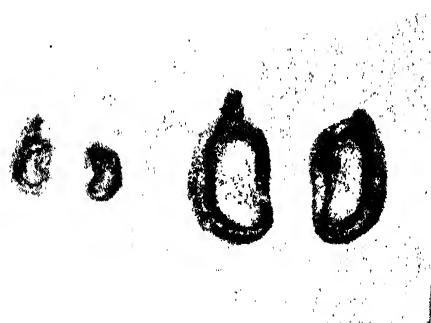


FIG. 1

The fruits looked like normal ones with well developed mesocarp and endocarp, but the embryo was found completely inhibited in growth with a shallow cavity inside the endocarp or stone. The ovary tissues in mango are found to respond differently to β -naphthoxyacetic acid, resulting in parthenocarpic development. Some improvement in fruit set was also noticed. These preliminary observations open up a fertile field for improving fruitage in mango through hormone treatment.

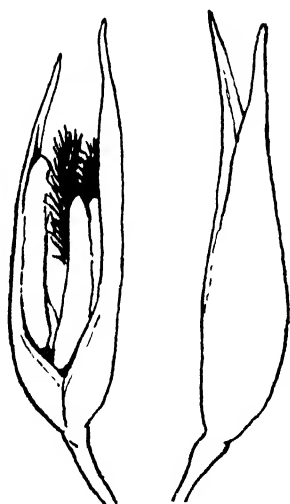
L. VENKATARATNAM.

Plant Physiology Laboratory,
Agricultural College, Bapatla,
August 17, 1949.

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PROTOGYNY IN INDIAN FORMS OF *SACCHARUM SPONTANEUM*

PROTOGYNY in only one African form (*Uganda*) of *Saccharum spontaneum* (known as 'Kans' in Hindi) was reported by Dutt and Krishnaswami,¹ but not in any Indian form uptill now. An examination of the *Spontaneums*, collected by the writer under the *Spontaneum Expedition Scheme*, financed by the Indian Central Sugarcane Committee, shows that 4 types (SES* 29, 32 B, 65 and 66) out of the 94 collected so far are protogynous. The phenomenon is not so conspicuous as in the *Uganda* form, as the stigmas do not project out of the glumes. But the glumes are found to open out making the bright maroon-pink coloured stigmas well exposed, at least 24 hours earlier than the bursting of anthers in the same flower (Figs. 1 & 2).



Protogynous Normal
Flower Flower
24 hrs. before anthesis

FIG. 1. Showing an enlarged drawing of a normal and a protogynous flower.

The receptivity of the stigmas in the protogynous flowers of the above types was tested by the setting of seeds and their germination, after bagged pollination of emasculated flowers. SES 29, 32 B, 65 and 66 were used as mothers, selected branches of which were emasculated and bagged after pollination with the pollen from SES 69, 44, 66, 44 and 71 respectively. The seeds collected from the pollinated branches germinated, whereas in the 'general crosses' (where the panicles were kept as

it is) most of the seeds did not germinate. SES 66 showed better receptivity and SES 44 is indicated to be a good pollen parent. Direct observation of the stigmatic branches after pollination also shows that the pollen germinates on the stigma, giving out long tubes.



FIG. 2. A microphotograph of a protogynous flower. Note the prominently exposed stigma and unopen anther.

The present observation regarding the occurrence of protogyny in the Indian forms of *S. spontaneum*, and the receptivity of the stigmas at that stage has opened up the possibility of using the Indian spontaneums also as female parents in sugarcane breeding. This will have a definite use also in genetical studies.

Thanks are due to Sri. N. L. Dutt, Sugarcane Expert, Coimbatore, for formulating the scheme and for keen interest in the work.

SUNIL KUMAR MUKHERJEE.

Spontaneum Expedition Scheme,
Indian Sugarcane Breeding Station,
Lawley Road P.O.,
Coimbatore,
July 6, 1949.

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* SES means '*Spontaneum Expedition Scheme*'.

'ON THE CHROMOSOMES OF A CRICKET, *LIOGRYLLUS BIMACULATUS*

ACCORDING to Japanese workers the X-chromosome in crickets is metacentric. The two exceptions are *Cyrtoxiphus ritsemæ* and *Homæogryllus japonicus* (Ohmachi ^{1,2}). The present work reports on the X-chromosome and the diploid number of chromosomes in an Indian cricket from Ballygunge in Calcutta.

Testes and ovaries of the material were fixed in Flemming's without acetic acid and also in Belling's modification of Navaschin's mixture. The gonads after sectioning were stained in both iodine crystal violet and Feulgen's stain. The chromosome number was found to be $2n=23$ in the male and $2n=24$ in the female. The complement in the male is composed of (1) an unpaired, metacentric X-chromosome, (2) a pair of V-shaped chromosome and (3) 10 pairs of rod-shaped ones of various sizes (Fig. 1).



FIG. 1. Spermatogonial metaphase of *Liogryllus bimaculatus* $\times 2270$.

FIG. 2. Metaphase plate from the follicle cell of ovary $\times 2625$.

FIG. 3. Side view of first meiotic metaphase showing the "X" lying off the plate. $\times 1750$.

The sex chromosome was found to be the biggest in the complement with two arms unequal. It showed almost always an irregular outline and never became fully nucleinated like the autosomes even at late spermatogonial metaphase stages. The female complement differed from that of the male in having a pair of metacentric X-chromosomes (Fig. 2). The sex chromosomes of the female set were studied from the follicle cells of the ovary and they did not show any heteropycnotic behaviour. The X-chromosome in the prophase of meiosis in the male resembled sometimes a bent rod, split along its length and highly nucleinated, and at other times a compressed mass situated at the periphery of the nuclear membrane. In the first meiotic metaphase this chromosome formed an accessory plate in most cases (Fig. 3), and

also showed negative heteropycnosis. Lagging of the sex chromosome was noted in some nuclei. The second division metaphase plates contained either 11 or 12 chromosomes showing that the first meiotic division of the male is reductional for the sex chromosome.

The work was carried out in the Cyto-genetical Laboratory of the Department of Zoology, Calcutta University. Thanks are due to Dr. S. P. Ray Chaudhury for criticism and to Prof. B. R. Seshachar, Bangalore, for identification.

Animal Genetics Section, M. K. DUTT.
Indian Vet. Res. Institute,
Izatnagar (U.P.),
August 9, 1949.

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NECROSIS IN TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

TOMATO PLANTS (*Sutton's Early Market Variety*), when inoculated with leaf extract of potato plants showing severe crinkling and mottling, repeatedly produced veinal necrosis and necrotic spots. The disease was reproduced easily by sap inoculation to healthy tomato plants (Fig. 1).



FIG. 1

The inoculation tests were mostly conducted during February-March at Delhi in the insect proof house. The first symptom of the disease in the form of curling of leaves

with slight inward rolling of margins appears 20 to 22 days after inoculation, followed by both veinal and foliar necrosis. Necrotic streaks are also produced on the petioles. Transient mottling is observed only in early stages. The infected plants are dwarfed and tend to shed their leaves.

The disease from tomato plants was transmitted to *Nicotiana tabacum* L., *Datura stramonium* L., *Solanum nodiflorum* Jacq., *Petunia hybrida compacta* Vilm., by mechanical inoculation but no symptoms were produced on plants of *Lagenaria leucantha* (Dusch.) Rusby. On *Nicotiana tabacum*, variety *Harrison's special*, five days after inoculation circular mottle was observed. This was followed by vein clearing of younger leaves and green vein banding. In the case of *Datura stramonium* (Fig. 2) persistent, interveinal mottle was observed 5 to 10



FIG. 2

days after inoculation but no necrosis developed. On *Solanum nodiflorum* characteristic yellowish veinal mosaic was produced whereas *Nicotiana glutinosa* developed chlorotic spots and vein clearing. Puckering and necrotic flecks were also observed on the leaves. On *Petunia hybrida* distinct pale blotchy mottle on the leaves and sepals with vein clearing developed.

The reactions on different hosts indicate that the tomato plant showing necrosis was infected both with *Solanum viruses* 1 and 2. Further tests with *Solanum virus* 1 filtered

through *Datura stramonium* failed to produce the typical symptoms of the disease. It was not possible to eliminate *Solanum Virus* 1 by making inoculations of the mixture to *Petunia* as the variety of *Petunia* plants under test was found susceptible to it, and in order to separate *Solanum Virus* 2 from the mixture tomato shoots showing the disease were grafted to U.S.D.A. potato seedling 41956 which is known to be resistant to *Solanum Virus* 1. The potato plants exhibited veinal necrosis and leafdrop streak. Scions from the potato plants were grafted back to healthy tomato plants but no necrosis was produced on tomato plants even after one month.

Smith⁵ has described necrosis in tomato caused by the interaction of *Nicotiana Virus* 1 and *Solanum Virus* 1 in which case gross lesions develop longitudinally in the stem and necrotic spots on the leaves. The young tomato plants are usually killed by the disease whereas in the case of the disease under report the affected plants neither produce lesions on the stem nor the plants are killed.

Samson⁴ observed necrosis in tomato induced by a strain of *Nicotiana Virus* 1. Also Linn and Anderson³ reported a similar disease. Doolittle and Beecher¹ described a mosaic disease due to a strain of tobacco mosaic virus on tomato causing necrosis and shrivelling of the foliage.

Dykstra² has, however, observed necrosis of tomato leaves as a result of inoculation with the extract of potato plants infected with rugose mosaic.

Tests conducted here rule out the presence of *Nicotiana Virus* 1 and show that either of the components of the virus transmissible to *Datura stramonium* or to U.S.D.A. potato seedling 41956 is not able to produce the disease on tomato independently so that the necrosis observed on tomato has been brought about jointly by *Solanum Viruses* 1 and 2.

Thanks are due to Dr. S. P. Doolittle, Senior Plant Pathologist, U.S.D.A., for his helpful criticism.

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R. P. GARGA.
R. N. AZAD.

Division of Mycology
and Plant Pathology,
Indian Agric. Res. Institute,
New Delhi,
September 26, 1949.

1. Doolittle, S. P. & Beecher, F. S., *Phytopath.*, 1942, 32, 11, 985-94. 2. Dykstra, T. P., *Jour. Agric. Res.*, 1933, 47, 1, 17-32. 3. Linn, M. B. & Anderson, H. W. "The Plant Disease Reporter," 1942, 26, 21, 452-54. 4. Samson, R. W., *ibid.*, 1942, 26, 16, 361-64. 5. Smith, K. M., A "Text-Book of Plant Virus Diseases" (J. & A. Churchill Ltd., London).

PHOTOPERIODIC RESPONSE IN SOME X-RAY MUTANT WHEATS

STUDIES on photoperiodism of wheat under Indian conditions have been carried out by Pal and Murty,¹ Kar,² Chinoy and Nanda.³ The present investigation is directed towards a study of the stage of optimum response to photoperiods in two new strains of wheat, R-1 (Sarojini) and R-9 (Vijaya), proved to be the best (Pugh⁴) of the eleven varieties evolved by Prof. Ranjan.⁵ These mutants vary widely in their morphological and physiological characteristics and the present study has been designed to test if their photoperiodic response follows the general trend of other Indian wheats.

The seeds were sown in earthenware pots (11" x 10") containing well-mixed garden soil and manure. As long-day treatment, a 24-hour photoperiod was used. This was obtained by supplementing the natural day length with artificial illumination from a 1000 watt 'Osram' bulb kept at a distance of 4 feet throughout the night. The long-day treatment was continued till ear-emergence was complete in the individual pots.

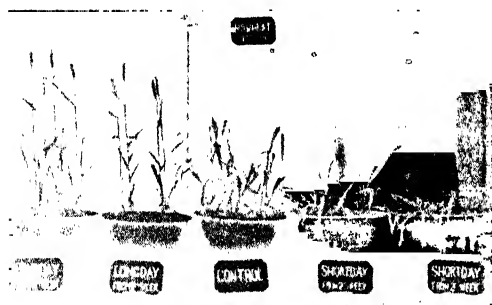


FIG. 1

As short-day treatment, an 8-hour photoperiod was used. This was obtained by keeping the pots in daylight daily from 8 a.m. to 4 p.m. and then removing them to a well-ventilated light-proof room for

the rest of the time. The exposure to short photoperiod in each individual set commenced at different stages of the vegetative phase (Table I) and was continued in each case for 30 days only after which they were kept outside under natural conditions for the rest of their period of development.

The results are presented in Table I and the condition of the plants under different treatments is shown in Fig. 1.

TABLE I

The effect of long-day and short-day treatments (at different ages of the seedlings) on ear-emergence

Sowing date, 27th December 1948. Average of 24 plants. + indicates earliness; - indicates delaying effect.

Variety of wheat	Age from sowing in days, at which the treatment was commenced	Number of days from sowing to ear-emergence		Difference from control in days	
		Long-day	short-day	Long-day	short-day
R-1	14	38.4	71.2	+23.0	-8.9
	21	42.0	69.4	+19.4	-7.1
	28	49.6	65.7	+12.7	-3.4
	35	51.6	64.0	+10.7	-1.7
	Control	62.3	62.3		
R-9	14	38.0	65.1	+21.6	-5.5
	21	42.3	62.1	+17.3	-2.5
	28	47.8	61.2	+11.8	-1.6
	35	50.6	59.8	+ 9.0	-0.2
	Control	59.6	59.6		

Table I shows that long-day conditions during the vegetative phase bring about significant earlier ear-emergence in both the mutants and that the effect is more pronounced if the long days are applied at the early seedling stage. As the seedlings become older, the long photoperiods produce less and less effect in inducing earliness. It was found that short-day treatment always retards flowering, the effect gradually diminishing as the treatment is applied later and later in the advancing age of the plant.

The present study clearly shows that the mutants under investigation resemble the other Indian varieties in the general trend of their photoperiodic response, and that long-day treatment during their vegetative phase accelerates their normal life-cycle, although as such they tolerate the available short days of India and set good grains.

Thanks are due to Professor Shri Ranjan for his interest and guidance.

Dept. of Botany, GADADHAR MISRA.
University of Allahabad,
September 14, 1949.

1. Pal, B. P., and Murty, G. S., *Ind. Jour. Genet. and Pl. Breed.*, 1941, 1, 61-86. 2. Kar. B. K., *Nature*, 1946, 157, 811. 3. Chinoy, J. J., and Nanda, K. K., *Ind. Jour. Agric. Sci.*, 1946, 16, 390-399. 4. Pugh, B. M., *Allahabad Farmer*, 1945, 19, 131-142. 5. Ranjan, S., *Proc. Ind. Acad. Sci.*, 1940, 12, 62-68.

EFFECT OF VERNALIZATION AND PHOTOPERIODIC TREATMENTS ON GRAIN DEVELOPMENT IN WHEAT

HIGHLY significant negative correlations between yield, 1000-grain weight and mean maximum temperature of the ripening period have already been reported elsewhere.² When the temperature of the ripening period exceeded a certain level the grain filling processes in wheat were affected and as a consequence of which the grain remained shrivelled and the yield was reduced.

In order to confirm the general applicability of the abovementioned result as well as to make sure that the effect of the temperature of the ripening period on yield and 1000-grain weight of wheat is paramount over other factors, vernalization and photoperiodic treatments were given to a number of wheat varieties selected from different flowering classes, for accelerating or retarding their developmental processes and thus synchronizing their ripening periods, either with a lower temperature range during February-March (75-80° C.), or with a higher temperature range during April-May (90-95° C.). Details of some of these experiments have already been given elsewhere.^{1,3,4} When flowering in early wheat varieties, like N. P. 165, Khapli and others, was delayed in order to shift the ripening period to hotter months, the yield per plant was reduced to 3-5 g. from 10-15 g. and 1000-grain weight to 20-25 g. from the normal figure of 40-45 g. The ripening period was also shortened from 50-60 days to 30-35 days. On the other hand, when flowering was accelerated in late varieties like Yeoman II, Kubanka, Vaneum Yakub, and others, by vernalization and photoperiodic treatments, thus making it possible

for these varieties to ripen their grain in February-March, it was found that the yield increased from 2-4 g. to 7-10 g., the 1000-grain weight from 15-20 g to 40-45 g. The ripening period was considerably lengthened from 20-30 days to 40-60 days due to lower temperature.

The usefulness of this physiological method of varying environmental conditions may be seen from the fact that the conclusions arrived at earlier² have been repeatedly confirmed during the last eight years by experiments on vernalization and photoperiodic responses of wheat carried out at the Indian Agricultural Research Institute, New Delhi, and also at the University of Delhi, Delhi.

Botany Department,
University of Delhi,
Delhi,
October 11, 1949.

J. J. CHINYOY.

1. Chinoy, J. J., and Nanda, K. K., *Indian J. Agri. Sci.*, 1946, 16, 390. 2. Chinoy, J. J., *Nature* (London), 1947, 159, 442. 3. —, *Ibid.*, 1949 (in press). 4. Nanda, K. K., and Chinoy, J. J., *Curr. Sci.*, 1945, 14, 241.

PROLIFERATION OF GRASS SPIKELETS

In *Current Science*, August 1949, 18, No. 8, 301-02, a letter appears entitled 'Proliferation of Spikelets in *Pennisetum Polystachyum*'. For those interested, the following reference may be useful : —

Jenkin, T. J., "Notes on Vivipery in *Festuca Ovina*", Report for 1921 of the Botanical Society and Exchange Club of the British Isles. T. Buncle & Co., Arbroath, 1922.

T. J. JENKIN, D.Sc.,
Director.

Welsh Plant Breed. St.,
Aberystwyth, Wales,
September 28, 1949.

OCCURRENCE OF TURIONS IN *ELODEA CANADENSIS*

Elodea canadensis Michx is a rapidly multiplying common pond weed in South India. Specimens collected during summer when the ponds were rapidly drying up, showed small tuberous structures (Figs. 1 & 2) which proved to be turions reported in the pond weeds of temperate regions.¹

Plants like *Myriophyllum verticillatum* L. and *Potamogeton* sp., develop turions under adverse conditions and germinate and produce new shoots under favourable

Fully developed turions are tuberous, cinnamon-brown and covered with scale leaves. In transverse sections they show the growing point in the centre and several enveloping layers of scale leaves which are studded with food material, and give a blue colouration with IKI.

Turions collected during April and May were hard and ovate to spherical in shape. Those collected in July, following the commencement of rainy season, showed early stages of germination and consequent regeneration of new shoots. Longitudinal sections of turions at this stage showed the rapidly developing apical shoot (Fig. 3), with its nodes and internodes.

It appears that adverse weather conditions such as low temperature, lack of water resulting in a severe competition for food and space among the plants induce turion formation. In the present case drought and consequent drying up of ponds are probably the chief causes for turion formation.

Grateful thanks are due to Dr. P. Maheshwari, Dr. L. N. Rao and Dr. M. J. Thirumalachar for the help in preparing this note.

Bangalore,
October 10, 1949.

K. M. SAFEEULLA.
H. C. GOVINDU.

Arber Agnes, "Water Plants" (1920).

ON THE NECTARY IN THE STAMENS OF *MEMECYLON HEYNEANUM* BENTH.

Memecylon Heyneanum belongs to the family Melastomaceae which is characterised by the presence of peculiar appendages on the connectives of anthers. Ziegler¹ has described the structure and biological interest of these appendages in several species. In the present form there are eight incurved stamens whose connectives are prolonged at the back to form very characteristic horn-shaped appendages, bluish in colour (Fig. 2). Each appendage bears a nectary facing the style in the bud (Figs. 1-2).

The nectary is broad and funnel-shaped (Fig. 4) and its outermost layer consists of narrow elongated palisade-shaped cells with conspicuous nuclei and dense cytoplasm. The vacuoles are present at the basal end only. This is the secretory layer

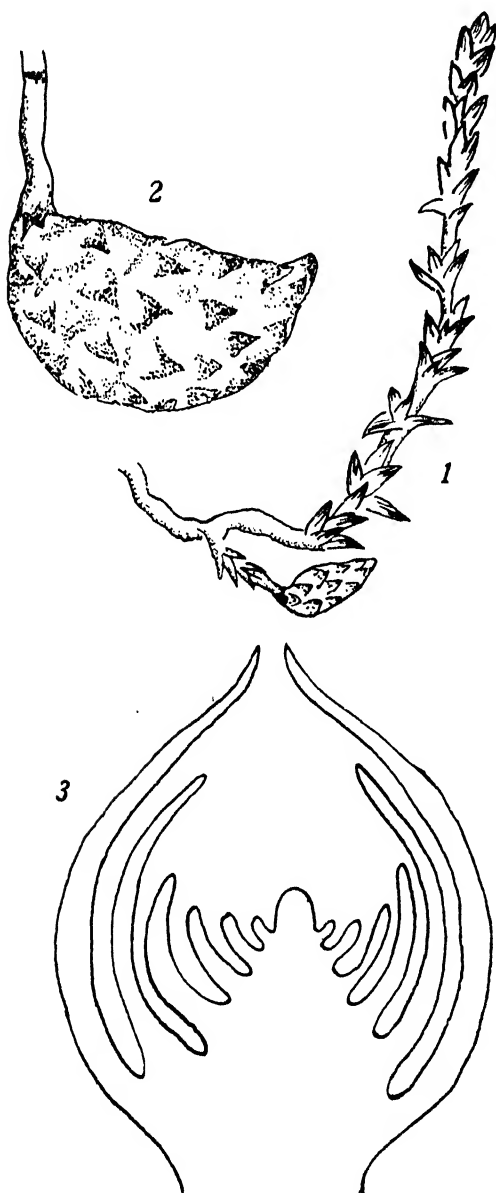


FIG. 1. Showing turion \times Natural size.

FIG. 2. Enlarged view $\times 4$.

FIG. 3. Longitudinal section showing the apical shoot $\times 6$.

conditions. Several of the turions in *Myriophyllum verticillatum* detached from the mother plant during cold season regenerate new shoots in spring.

of the nectary followed by two to three layers of compactly arranged parenchymatous cells.

The single vascular trace entering the filament finally reaches the connective of the anther. Here it gives out a branch passing further up into the horn-shaped appendage and ending blindly at its apex

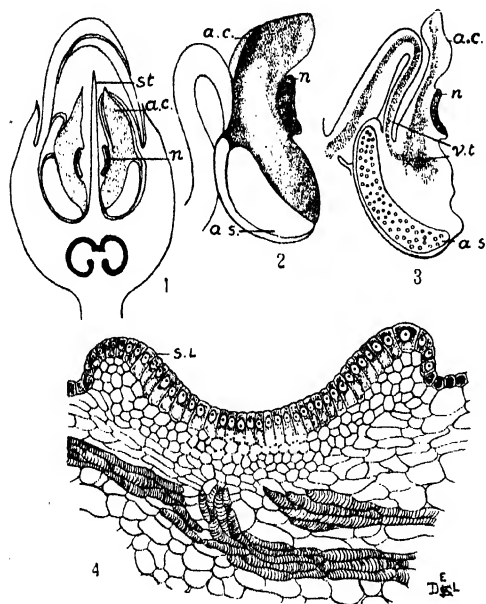


FIG. 1. L. S. of a young flower bud (semidiagrammatic). FIG. 2. A stamen enlarged showing the connective, appendage and nectary. $\times 23$. FIG. 3. L. S. of same showing vascular supply. $\times 23$. FIG. 4. L. S. nectary (a.c., appendage of the connective; a.s., anther sac; n, nectary; s.l., secretory layer; st., style; v.t., vascular trace.) $\times 175$.

(Fig. 3). In the appendage of the connective the vascular trace spreads itself broadly and sends some branches to the base of the nectary.

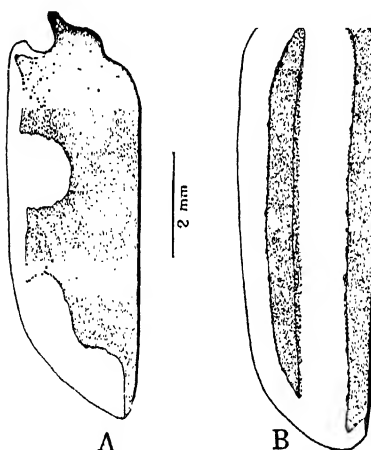
I thank Prof. P. Maheshwari for suggestions, the National Institute of Sciences of India, for the award of a junior fellowship, and the authorities of the University of Delhi for laboratory facilities.

Dept. of Botany, K. SUBRAMANYAM.
University of Delhi,
November 2, 1949.

1. Ziegler, A., "Beiträge zur Kenntnis des Androeceums und der Samenentwicklung einiger Melastomaceen," *Bot. Arch. Mez.*, 1925, 17, 212-312.

CICINDELIDS FROM KRUSADAI ISLAND AND KUTIKAL POINT IN THE GULF OF MANNAR

THE commonest diurnal insects on the sandy shores of the Krusadai island are the cicindelids (*Cicindela biramosa* F.). Another larger species, *C. quadrilineata* var. *renei* Horn, characterised by longitudinal stripes on the elytra (vide figures) is to be met with while walking from Pamban to



The right elytron of

(A) *C. biramosa*

(B) *C. quadrilineata*

Kutikal Point along the southern coast of the Rameswaram island. A detailed account of these beetles will be published later.

Thanks are due to Dr. N. C. Chatterjee, Forest Entomologist, Dehra Dun, for identifying the species.

Sanatana Dharma College, J. SAMUEL RAJ.
Alleppey, S. India, K. V. VERGHESE.
October 26, 1949.

A POSSIBLE EXPLANATION OF THE JOSHI EFFECT

PROF. JOSHI's postulate of the surface layer origin of the Joshi Effect Δi appears probable.^{1, 2, 3, 23, 24, 25, 4} Its various determinants follow from the photo-voltaic behaviour of a singlet-formed^{16, 17} wall complex $W^{+1/2} (XY)^{-1/2}$. It is assumed that (i) this complex is stabilised owing to the electron donating property of a semiconductor, e.g., glass (ii) under the

operating fields ($\leq V_m$, the threshold potential) the complex ionises into $(W.XY)^+ + e(-)$ and the latter contributes to the discharge current i ; and finally (iii) light dissociates the complex into either, or/and (a) $W + XY$, (b) $W^+ + XY^-$, (c) $WX + Y$, (d) $(WX)^+ + Y^-$. The light action introduces, therefore, negative ions in lieu of electrons as in (ii) or/and neutral particles, causing Δi . Enhanced temperature instabilises the complex and therefore reduces Δi , as reported.^{2, 5} The favourable effect on Δi of a rise in gas pressure¹² follows from the corresponding increase in the complex concentration; similarly, ageing^{1, 2, 13, 14, 24, 25} under the discharge favours it. An increase of light frequency^{1,3,6,7} and intensity^{20, 3, 8, 13, 15} should aid (iii) and therefore, Δi . The boundary complex being the photosensitive material, primary to Δi , its non-dependence on selective absorption of the excited gas is to be anticipated^{1, 26}; as also the profound influence of the wall material^{1, 5, 27} and the comparatively greater Δi in transverse than in longitudinal irradiation.^{21, 22}

The complex formation should develop with gases possessing resonating semipolar single bond structure^{18,19}; or with a tendency, under excitation, to pass into that structure whether single or multibonded, e.g. $W^{+1/2} \cdot O \cdot (O)^{-1/2}$ or $W^{+1/2} \cdot H \cdots (OH)^{-1/2}$ in order to accept the electron donated by the wall molecule W . The observed order in respect of Δi in various elementary gases follows, viz., $Cl_2 > Br_2 > I_2 > O_2 > N_2 > H_2 > Ne$. Due to polarisation from complex formation, surface layer ionises²⁸ at a lower voltage V_m . At higher voltages unpolarised molecules even in the bulk start ionising when surface ionisation becomes unimportant. This explains the appearance of maximum Δi near V_m implied in (ii) and its decrease thereafter.^{2,5,7,10,11} Since large potentials are required for conduction at large gas pressures the inhibitive influence of the latter follows.¹²

A typical result in this field that Δi is linked preferentially with the H.F.s^{9,10,11} may now be considered. The ozoniser is essentially a compound condenser² discharging once every period through an internal resistance, characteristic of the excited gas, which is inverse of the associated con-

ductivity. The observed decrease of the latter (as in Δi) should reduce the H.F.s since the resistive damping increases rapidly with the frequency.^{1,10}

Joshi has generalised that a $+\Delta i$ occurs at low applied potentials² and ascribed it *inter alia* to a simple photoelectric effect at the boundary layer uninterfered with by secondary changes. On the basis of the theory now advanced, at low applied V , the process (ii) is negligible. Irradiation leading to (iii) should release negative ions and therefore, enhance the conductivity constituting the positive Joshi Effect.^{1, 2, 11}

Our grateful thanks are due to Prof. S. S. Joshi, D.Sc. (London), F.R.I.C., F.N.I., for his valuable suggestions and kind help.

SAIYID SHAMIM-AHMAD,

Chemistry Dept.
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M. V. RAMANAMURTI.

Hindu University, Banares.
August 22, 1949.

1. Joshi, *Pres. Addr. Ind. Sci. Cong. Chem. Sec.*, 1943, 2. —, *Curr. Sci.*, 1947, 16, 19. 3. — *ibid.*, 1945, 14, 35. 4. —, *ibid.*, 1945, 14, 175. 5. —, *ibid.*, 1946, 15, 281. 6. —, *ibid.*, 1944, 13, 278. 7. — 1945, 14, 317. 8. — and Deo *ibid.*, 1943, 12, 306. 9. —, *ibid.*, 1945, 14, 67. 10. —, *Proc. Ind. Acad. Sci.*, 1945, 22A, 389. 11. —, *ibid.*, 1945, 22A, 225. 12. — and Deo, *Nature*, 1944, 153, 434. 13. —, *ibid.*, 1943, 151, 561. 14. Deo, *Proc. Ind. Acad. Sci.*, 1945, 21, 76. 15. —, *Ind. J. Phys.*, 1944, 18, 83. 16. Ingold, *J. Chem. Soc.*, 1926, 1315. 17. Sugden, "Parachor and Valency," Routledge ed. 1930, p. 131. 18. S. Shamin-Ahmad, *Proc. Ind. Sci. Cong. Chem. Sec.*, 1948, A. No. 19. 19. —, *ibid.*, 1949, A, No. 64. 20. Deshmukh, *J. Ind. Chem. Soc.*, 1947, 24, 211. 21. Prasad, *Proc. Ind. Sci. Cong.*, 1947, *Phys. Sec.*, A, No. 17. 22. Tawde and Gopalkrishnan, *Proc. Ind. Acad. Sci.*, 1949, 29, 171. 23. Venkateshwar Rao, *ibid.*, 1948, 27, 72. 24. Ramanamurti, *J. Ind. Chem. Soc.*, 1948, 25, 255. 25. Goel, *ibid.*, 1947, 21, 203. 26. Venkateshwar Rao, *Proc. Ind. Acad. Sci.*, 1949, 29, 211. 27. Cherian, *Proc. Ind. Sci. Cong.*, *Phys. Sec.*, 1945, A, No. 17. 28. Birr, E. J., *Z. physik. chemie.*, 1933, A 165, 311. 29. Deo, P. G., *Phil. Mag.*, 1948, 39, 978.

ARTIFICIAL INFECTION OF SORGHUM WITH LONG SMUT

LONG smut of sorghum caused by *Tolyposporium ehrenbergii* (Kuhn.) Pat. has been recorded in South India (Barber, 1909), the Punjab and Bombay. The sori are reported to be few in each ear and an inch or more in length.

The mode of infection of this smut is so far unknown. Several inoculation experiments carried out at the Indian Agricultural Research Institute, New Delhi, have failed to reproduce the disease (Scientific Reports, 1947). Mundkur (1945) surmises that infection may be through the flower.

In May 1949, a severe cutbreak of this smut was noticed in several places. Many sori were noticed in each ear and a high percentage of the plants was affected. Viable spore material from this crop was utilised for inoculation at Coimbatore. The spores readily germinated producing many sporidia. Preliminary inoculation experiments were carried out in August in the field on a crop of Co 11 strain of sorghum, by (1) spraying a suspension of germinating spores on the ears, just emerging from the boot leaf, (2) brushing the spikelets of similar ears with the germinating spores, and (3) pouring a suspension of germinating spores inside the sheath of the boot leaf before the ears emerged. Controls were kept in all cases.

Fifteen days after inoculation, sori were observed only among plants inoculated by the third method. The experiments were repeated in an isolated plot in the pot culture house on a crop raised from disinfected seeds. Method (3) was adopted. Two days later, the ears emerged from the boot leaf. Successful infection was obtained again, the period of incubation being 12 to 15 days. The cultures of sorghum that were inoculated were Co 11, A S. 7589 and 7571 and all of them were affected. This successful artificial inoculation of sorghum by the smut proves that infection is through the young flower before the ear emerges from the boot leaf. In the second series, the ears were enclosed inside paper bags for four days after inoculation. The number of flowers infected per ear varied from one to seven.

This is in keeping with the intensity of infection observed in Coimbatore.

Mycology section, T. S. RAMAKRISHNAN.
Agric. Res. Institute, G. S. REDDY.
Lawley Road,
Coimbatore,
September 19, 1949.

1. Barber, C. A., *Madras Dept. Agric. Bull.*, 1909, 49, 276. 2. Mundkur, B. B., *Ind. J. Agric. Sci.*, 1945, 15, 109. 3. *Sci. Rep. Ind. Agric. Res. Inst.*, 1947, 110.

ULTRA-VIOLET ABSORPTION SPECTRUM OF IODOBENZENE

ABOUT 100 red-degraded bands have been photographed in the absorption spectrum of iodobenzene in the region $\lambda 2850$ to $\lambda 2400$. As in other monosubstituted benzene spectra¹, this band system corresponds to the allowed electronic transition $A_1 \rightarrow B_1$ with the electronic moment lying in the plane of the ring and perpendicular to the axis of substitution. The (0,0) band is located at $\nu 3\ 352$. Towards the red end, the bands correspond to Raman frequencies² 23, 340, 780, 900, 1010, 1100 and 1300. A strong band at 61 units from (0,0) is interpreted as giving a difference frequency of the $1 \rightarrow 1$ type of transition, analogous to 67 and 60 in monofluoro and monochlorobenzenes¹. A similar difference frequency of 90 cm^{-1} is also detected. Progressions of totally symmetric vibrations are observed on the violet side leading to upper state frequencies, 950 and 780.

A detailed discussion of the analysis will be published elsewhere.

Andhra University,
Waltair, K. SREERAMAMURTY.
November 8, 1949. K. R. RAO.

1. Spomer and Teller, *Rev. Mod. Phys.*, 1941, 13, 76; Spomer and Wollman, *J. Chem. Phys.*, 1941, 9, 816; Wollman, *Ibid.*, 1943, 14, 123, etc.
2. Teets and Andrews, *J. Chem. Phys.*, 1935, 3, 175.

REVIEWS

Modern Text Book of Intermediate Physics. (Volume One). By A. N. Banerjee. (Das Gupta & Co., Ltd., Calcutta), 1949. Pp. xiv + 224. Price Rs. 6/.

In the preface to the book the author mentions that he has taken pains to state the physical principles in simple language and to show their significance by applying them at once to phenomena with which young readers are quite familiar. In achieving these objects the author has succeeded to a remarkable extent. The treatment of the subject-matter in this first volume is under three heads — General Physics, Sound and Heat. Throughout the book the author has consistently tried to propound the basic principles of classical physics so as to be easily assimilated by the Intermediate student. The first impression of the book is that it is a well-planned text book with plenty of diagrams. A noticeable feature is the illustration of physical principles by a large number of phenomena drawn from every-day life. The treatment of Sound and Heat is fairly satisfactory. Puluj's frictional method of determining mechanical equivalent of heat could have been included. Under radiation correction, methods other than Rumford's compensation method could have been described. Nevertheless the subject-matter of Sound and Heat will meet the requirements of Intermediate students. But the handling of dynamics and statics under General Physics does not come up to the standard required by Mysore and Madras Universities. Topics like centre of gravity, simple machines, requisites of a good balance and equilibrium under concurrent and non-concurrent forces have not received the attention they require. This trouble arises no doubt from the vagaries of the Physics syllabus in different Universities, which handicap the text-book writers all over India by restricting the usefulness of their labour. It would not impair the serviceableness of a book if certain chapters, such as Properties of Matter and Simple Harmonic Motion in the present instance, have to be eschewed by a class of students; but a text-book will fail in its duty to a certain section of students if all the required portions are not included.

Exercises have been set at the end of each chapter; it is regrettable that a uniform procedure has not been followed in giving the answers to the numerical problems. While dealing with rotational motion on page 47, it would have been more precise to mention that

uniform rotation is meant, especially as this paragraph succeeds accelerated linear motion. Such drawbacks and errors of spelling noticeable here and there have arisen perhaps on account of the hurry in rushing through the publication simultaneously in three different printing presses. Looking at the paucity of Indian text-books on Physics, the present volume is a commendable attempt and I dare say that in the next edition it will be improved and enlarged so as to be useful to a greater circle of Intermediate students.

L. S.

Terrestrial Radio Waves. By H. Bremmer. (Published by Elsevier Publishing Company, Amsterdam, London & New York. London Office: Clever-Hume Press Ltd., 42-A South Audley Street, W. 1), 1949. Pp. x + 344. 91 Illustrations. Price \$ 6.75.

This book is a most welcome addition to the rather scanty literature available on the subject. It provides an excellent treatment of the mathematical—physical methods for the computation of transmitter fields. It is divided into two parts. Part I deals with the theory for a homogeneous atmosphere and Part II deals with the theory of inhomogeneous atmosphere. Thus, both the ground wave and sky wave propagation come up for adequate treatment. The most essential features of the recent literature on the subject have been successfully incorporated in the text. This adds considerably to the value of the book. Both the prospective investigator and the advanced student have in this book a collected and comprehensive account of the present position of the subject. As such, the book is indispensable to both.

Formulae which are very essential for numerical calculations of the ground wave field have been collected together. They can thus be used without going into the detailed mathematical derivations. Typical graphs have been well drawn and reproduced for the field of a 1 Kw transmitter. These features extend the utility of the book to the practical engineer.

The printing and get-up of the book are excellent. In brief, the book is worth its weight in gold and the author deserves all praise in producing a work of this type. It can be recommended as a valuable addition to the Mathematics, Physics and Communication Engineering Libraries.

S. V. CHANDRASHEKHAR AIYA.

Table of Sines and Cosines to Fifteen Decimal Places at Hundredths of a Degree.

By U. S. Department of Commerce, National Bureau of Standards, Applied Mathematics Series 5. (United States Government Printing Office, Washington), 1949. Price 40 cents.

The Applied Mathematics Series of which the volume under reference forms the fifth publication is intended to serve as a vehicle for the publication of mathematical tables, manuals and studies by the Mathematical Laboratories of the National Bureau of Standards. Trigonometric tables with decimal subdivision of the degree are of great convenience in numerous problems of applied mathematics. To meet the need for such tables, the present volume provides a tabulation of the sine and cosine to 15 decimal places at intervals of one-hundredth of a degree. The arrangement adopted here, of columns of sines and cosines side by side and also of the second central differences alongside, will be found convenient in many cases where both sine and cosine functions are desired for the same argument, or where Taylor's theorem is to be used for interpolation.

R. S. K.

An Elementary Text-Book of Organic Chemistry. By D. D. Karve (Dartane Bros, Poona 2), 1949. Pp. viii+192. Price Rs. 2-12-0.

This short course in organic chemistry designed for the I.Sc. and I.Ag. standards of the Bombay and Poona Universities is well-planned, the fundamentals being presented in a simple, easy and straightforward manner.

The opening chapter indicates the scope of organic chemistry as a distinct branch of study. This is followed by a chapter on the purification of carbon compounds. It would have been better if the methods of fractional and steam distillation had also been mentioned. The logical order should have been maintained as regards the 'qualitative' detection of the elements and their 'quantitative' estimation before the determination of molecular weight and assignment of molecular formula. The tests for halogens might have included confirmatory tests as well. Tests for their detection in the presence or absence of nitrogen could have been given. The fact that it is possible to read up to 0.001 of a degree with a Beckmann thermometer by means of a lens has been left out.

The treatment of carbon compounds is uniformly good. Wherever necessary, equations and neat line diagrams have been given. At the end of the book, a summary of the

preparation and properties of important compounds dealt with have been given in tabular form. Also, a list of questions covering the whole portion, as well as numerical problems of varied types, are appended for purposes of revision. But the book needs considerable enlargement if it is also to cater to the pass subsidiary standards of South Indian Universities. The book is not without lapses and omissions and corrections, which will no doubt be attended to in the next edition.

M. V. S.

A Community at the Crossroads. By Sapur F. Desai (New Book Co., Ltd., Bombay), 1948. Pp. 201. Price Rs. 10.

Notwithstanding its small size, the Parsi community has often led the rest in business, finance and philanthropy; while, sociologically, it is a close-knit endogamous community, jealously guarding its non-proselytising faith. Its amazing adaptability, as is to be seen from its language, customs, manners, etc., according to the many, is at once a source of its strength and weakness.

Mr. Sapur Desai's monograph of the above title is prefaced by a foreword by Sir H. P. Mody and an introduction by Prof. Jehangir J. Asana and reveals four principal features. The first one, which is by far the most valuable and treated at length, is a factual study of demography based on vital statistics on housing and health, and brings out forcefully the dysgenic tendencies of the community. In the next many recommendations are made for social orientation and the abolition of poverty. The short ethnographic survey which follows extends to the very earliest times, and leads to the conclusion that on their entry into India, the Parsis 'ringfaced' themselves with social, sectarian and racial barriers, and that while the effect of the first two is breaking down, the racial barrier is still a rigid force in the community.

On this score, we are asked to believe that there is something in it which is worth preserving. On page 165 we read: "It therefore behoves the community to keep out of intermarriage"; also, it should be left severely alone "in the interests of the world at large and India herself in particular". Is it a happy reflection that at a time when even the Anglo-Indian community is led to identify itself with the rest of the Indian communities, students of demography can still preach sectarianism in the name of science?

M. C. M.

SCIENCE NOTES AND NEWS

Radioactive Isotopes for Hospitals and Medical Centres

A miniature atomic pile has been designed in Britain for use in hospitals, medical centres and health research units.

The apparatus, known as Aspatron, produces radio-active isotopes. These isotopes remain active for periods ranging from eight hours to three weeks.

The equipment is portable and weighs barely two cwts. It produces isotopes by using uranium in the form of a pure oxide. This is arranged inside the apparatus in a specially designed pattern within a double wall of metal packed with the material which increases the efficiency of atomic reaction. There is no danger from radiation since its range is limited and nullified by adequate safeguards. The cost of each equipment is estimated at about £ 500 (Rs. 6,667).

Wave Propelled Boats

A method of driving a ship by wave motion, without the aid of sail or engine, has been devised by Mr. Sydney McCubbin, of Victoria, Australia.

His two model ships have each attached to them twin diverging metal arms fore and aft. The arms extend below the surface of the water. Across the ends of each pair a horizontal oblong paddle is attached by hinges.

In operation the arms change their position in the water when the ship's hull follows the contours of the swell. The movement of the arms agitates the paddles, and drives the vessel forward. The propulsion is thus based upon the principle of wave motion.

The inventor states that the device requires a reasonable wave form with a comparable amount of wind to function successfully. It was intended primarily as auxiliary power, and probably would be best suited to fishing craft and lifeboats. The arms and paddles could be so constructed, as to be folded inboard when not in use.

British-Designed Boilers

A factory at Agarpara, near Calcutta, will soon be manufacturing shell type boilers of British design for the ever-growing Indian market.

The boilers to be made there will be to designs supplied by Babcock and Wilcox and will be manufactured under licence from that firm. They are of a type used in many factories where a simple design is required and where there is a demand for "processed" steam (used for heating, drying and other purposes) in large quantities.

The agreement provides for a certain number of Indian engineers to receive instruction and practical training at the Babcock and Wilcox works at Oldbury, near Birmingham.

Zoological Society of India—Foundation Fellows elected in 1949

Dewan Anand Kumar (Solan), Dr. A. A. Ayer (Madras), Dr. K. N. Bahl (Lucknow), Dr. D. V. Bal (Bombay), Dr. J. L. Bhaduri (Calcutta), Dr. D. R. Bhattacharya (Allahabad), Dr. B. S. Bhimachar (Calicut), Dr. B. S. Chauhan (Calcutta), Dr. B. N. Chopra (New Delhi), Dr. B. K. Das (Hydrabad), Mr. M. N. Datta (Calcutta), Prof. R. Gopala Aiyer (Waltair), Dr. S. L. Hora (Calcutta), Dr. M. O. T. Iyengar (Calcutta), Dr. T. J. Job (Barrackpore), Dr. G. L. Kestiven (Singapore), Dr. K. B. Lal (Kanpur), Dr. M. S. Mani (Agra), Prof. H. R. Mehra (Allahabad), Prof. M. B. Mirza (Aligarh), Prof. A. B. Misra (Benares), Dr. K. S. Misra (Calcutta), Prof. M. A. Moghe (Nagpur), Dr. K. B. Nair (Trivandrum), Dr. N. K. Panikkar (Mandapam), Dr. H. S. Pruthi (New Delhi), Dr. L. S. Ramaswami (Bangalore), Dr. H. S. Rao (Mandapam), Dr. H. N. Ray (Mukhteswar), Major Dr. M. L. Roonwal (Dehra Dun), Prof. B. R. Seshachar (Bangalore), Prof. R. V. Seshaiya (Annamalai-nagar), Dr. S. B. Setna (Bombay), Lt.-Col. R. B. Seymour Sewell (Cambridge), Dr. Miss N. G. Sproston (Shanghai), Dr. B. Sundara Raj (Lucknow), Dr. Viswanath (Hoshiarpur), Dr. G. S. Thapar (Lucknow), Dr. A. Wolsky (Delhi).

Facilities for Advanced Studies in U.S.A.

In pursuance of the Education Ministry's scheme to bring out pamphlets giving detailed information about facilities for advanced studies abroad, another pamphlet called "General Information about the U.S.A." has

just been published. The pamphlet gives information about different types of higher educational institutions in U.S.A. as well as other useful information to students desirous of proceeding to the U.S.A. for advanced studies. It also gives an idea of the necessary preliminaries required of a student before proceeding on the journey.

It is a priced publication and is available from the Manager of Publications, Civil Lines, Delhi.

D.Sc. Degree Award in Spectroscopy

On the recommendation of the Board of Examiners consisting of (1) Dr. Earl K. Plyler, (Chairman) Physicist, Incharge of Infra-red Measurement, U.S. Department of Commerce, National Bureau of Standards, Washington, (2) Dr. Janes H. Hibben, Chief Chemical Division, United States Tariff Commission, Washington D. C., (3) Prof. David M. Dennison, The Harrison M. Randall Laboratory of Physics, University of Michigan, Ann Arbor, the thesis entitled "Spectroscopic Behaviour of Diamond and Other Crystals" by Mr. K. G. Ramanathan, M.Sc., has been declared as qualified for the degree of Doctor of Science (D.Sc.) of the Andhra University.

It may be recalled that Mr. K. G. Ramanathan was recently awarded the 1851 Exhibition Scholarship.

D.Sc. Awards in Chemistry

On the recommendation of the Examiners, Board consisting of Sir J. L. Simonsen, Kt., F.R.S., Prof. H. J. Emeleus, F.R.S., Prof. Garner, F.R.S. and C. K. Ingold, F.R.S., Messrs. G. S. Deshmukh, M.Sc. and D. Singh, M.Sc., have been awarded D.Sc. in Chemistry for the work on 'Studies of the Joshi Effect' in Gases and in Electrolytes, respectively, by the Benares Hindu University.

ISO Committees on Shellac and Mica

The Technical Committees of the International Standards Organisation for Shellac and

Mica will meet in Delhi for the first time in India between January 16 and 19, 1950.

Australia, Belgium, France, Netherlands, New Zealand, Poland, the U. K. and the U. S. A. have been invited for the meeting of the Committee on Shellac. Brazil, Czechoslovakia, France, Hungary, the U. K. and the U. S. A. are the invitees for the meeting of the Committee on Mica. The Sectional Committees of the ISI on Shellac and Mica will constitute the Indian Delegations at these meetings.

Proposals on specifications for seedlac, shellac, dry bleached shellac, classifications of and methods for grading processed mica will be discussed at these meetings with a view to the formulation of international recommendations.

Biochemical Congress

The first International Congress of Biochemistry was held at Cambridge recently.

It was initiated by the Biochemical Society with the support of the International Union of Chemistry. Prof. A. C. Chibnall presided over the session and Prof. E. C. Dodds acted as the Chairman of the Executive Committee.

Sections covered include animal nutrition and general metabolism; structure and synthesis of biologically important substances; cytochemistry; biological pigments; oxygen carriers and oxidising catalysts; hormones and steroids, chemotherapy and immunochemistry; plant biochemistry and industrial fermentations.

IXth International Congress of Entomology

The IXth International Congress of Entomology will be held on August 17th-24th, 1951, in Amsterdam (Netherlands). Entomologists wishing to receive in due course programmes and application forms are requested to communicate already now with the Secretariate c/o. Physiologisch Laboratorium, 136 Rapenburger straat, Amsterdam.

Further communications will follow in 1950.

INTERNATIONAL CONFERENCES

Date	Subject of Conference	Convening Body &/or Organisers	Location
Dec 26-31 ..	116th Annual Meeting of the American Association for the Advancement of Science	American Association for the Advancement of Science	New York
Dec. ..	1st Congress of the American Union of Occupational Medicine	Gen. Secretary, Avenales 981, T.W. 42, Callao 1015, Buenos Aires	Buenos Aires
Feb. 28, 1950 ..	Conference on Pneumosilicosis	Dean, School of Public Health and Tropical Medicine University of Sydney	Sydney, Australia
Mar. 20-23 ..	Convention of Electric Railway Traction	Institution of Electrical Engineers, Savoy Place, W.C. 2	London

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BOMBAY,
7th December 1949.

S. R. DONGERKERY,
University Registrar.

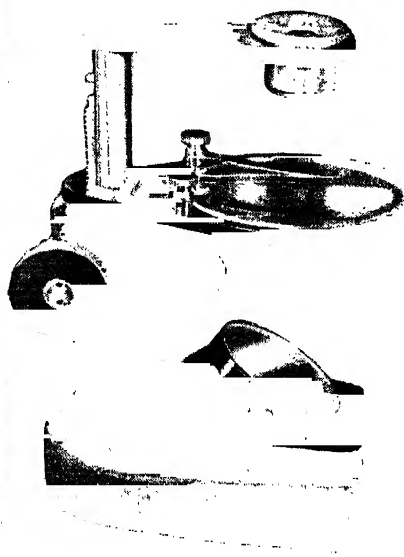


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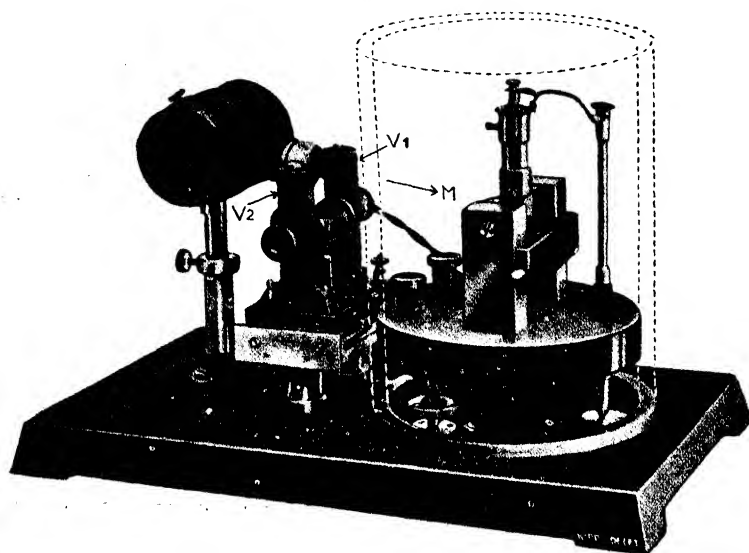
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Current Science

Vol. XVIII]

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[No. 12

	PAGE		PAGE
<i>Scientific Liaison</i>	423	<i>Science and Theosophy.</i> R. NAGARAJA	
<i>Medical Books in Tippoo Sultan's Library</i>		SARMA	430
D. V. S. REDDY	425	<i>Building Research in India</i>	432
<i>A South Seas Observatory</i>	426	<i>Modern Synthetic Rubbers.</i> J. C. GHOSH.	433
<i>Protein Hydrolysates for the Micro-Biological Assay of Amino-Acids.</i> R. RAM MOHAN, K. C. THADHANI, V. S. GOVINDA-RAJAN AND M. SREENIVASAYA	427	<i>Microbiological Assays.</i> V. S. G.	434
<i>Special Library Service.</i> G. T. KALE	429	<i>Trips to the Moon by 1960</i>	434
<i>Trials, Duties and Rewards.</i> SIR S. S. BHAT-NAGAR	429	<i>Letters to the Editor</i>	435
		<i>Reviews</i>	452
		<i>Obituary—Prof. August Krogh</i>	458
		<i>Science Notes and News</i>	459

SCIENTIFIC LIAISON

THE objectives of scientific liaison may be classified as follows:

- (1) Establishment and maintenance of personal contact with the scientists and technologists of the region in question, and with the institutions—governmental, university, and industrial—in which they work. This naturally involves a considerable amount of travelling, and the liaison officers have to be prepared for the inevitable discomforts and even dangers incidental to travel in non-industrialized countries.
- (2) Establishment of the liaison office as a clearing-house and information centre for the supply and distribution of
 - (a) scientific literature, whether

in the form of original journals and papers, microfilms and their reading machines, photostats and all kinds of documentation,

- (b) essential scientific equipment and materials, ensuring that they reach the proper recipients in the region,
- (c) scientific information already existing on problems in the region,
- (d) ideas and suggestions which might be obtained from the centres of science and technology in the advanced countries to meet specific problems in the region.

- (3) Facilitation of the outward movement of scientific and technical reports from laboratories and other sources in the region, and its scientific journals, to the main centres of science and technology.
- (4) Help in informing the outside world of interesting and important work being carried out in the region.
- (5) Arrangements for the exchange of scientific correspondence and manuscripts, scientific papers, articles and reviews for publication.
- (6) Provision of scientific advice, when required, to governments of the region; and co-operation with bilateral scientific missions, scientific attachés and government service scientists who may be working in the region.
- (7) Facilitation of visits, which may be of short duration, by eminent scientists to the region, and encouragement of all plans for international collaboration in research and co-operative expeditions.
- (8) Co-operation with, and when necessary, advice to, the other Specialized Agencies of UN.
- (9) Assistance to all schemes of personnel exchange across the boundaries of the region.

One might summarize by describing the primary function of Unesco's Field Science Co-operation Offices as one of "facilitation" including the collection, exchange and dissemination of scientific information in a two-way flow, between each particular region and the rest of the world.

How do the liaison officers carry out their work?

Technical advice is given immediately wherever possible, but when this is not possible, they either write to specialists outside their area for the information required, or pass on the question to the Headquarters Unit at Unesco House, Paris, where the staff endeavour to obtain replies, either by consulting the other members of the scientific secretariat, or by further recourse to outside authorities. Besides the Headquarters Unit of the Field Sciences Co-operation Offices,

Unesco's scientific secretariat includes specialists in Pure, Medical, Agricultural and Engineering Sciences, Scientific Documentation and Apparatus, and the Social Implications of Science and History of Science. At Unesco House, again, the Libraries Division has a wealth of information on book and periodical exchanges between libraries; the Exchange of Persons Department constitutes the world clearing-house for all internationally available fellowships and studentships; and there are the Departments of Education and Culture. Through the Unesco Office in New York, microfilms and other forms of documentation, or special samples of chemicals produced in U.S.A. may be obtained. The Headquarters Unit has access to the library of the French *Centre National de la Recherche Scientifique* for reference, and may obtain bibliographies from the *Commission Internationale des Industries Agricoles*. Last but not least, Headquarters Unit can appeal to the secretaries of the various International Scientific Unions, of which mention has already been made, who are in a position to give the most authoritative information on the present state of any particular question, or who can indicate what specialist in what country should be applied to for the information needed.

The various Field Offices maintain contact with one another. This is worth while emphasizing, since, side by side with Unesco's network, the offices of the cultural relations organizations in various countries still provide a most important means of conveying scientific information to enquirers. Thus, during the war, it was the experience of members of the Sino-British Science Co-operation Office that if a Chinese scientist requested some information about scientific work going on in England, it was relatively easy to obtain it for him without delay, but if he made a similar request for the information about Swedish or Venezuelan work, the matter was not so simple, as no regular machinery existed for getting it. This multi-lateral service is exactly what Unesco's Field Offices are able to provide.

(By courtesy of UNESCO publications)

EDICAL BOOKS IN TIPPoo SULTAN'S LIBRARY*

D. V. S. REDDY

(Professor of Physiology, Madras Medical College)

IN the course of my search for old medical books, especially those written by medical men who served in India on the common diseases and treatments prevailing in the country, in the 18th and 19th centuries I fortunately encountered upon a veritable vein of gold in Mysore when I came across a list of books in the library of the Tippoo Sultan of Mysore, distinguished for his enlightened patronage of learning and reputed for his deep and extensive scholarship. He was a great lover of books and owned a magnificent collection of very valuable and rare volumes.

After the fall of Tippoo Sultan and the capture of Srirangapatnam in 1809, the British displayed commendable foresight and devotion to science in their decision to preserve the library of Tippoo Sultan. A few manuscripts were selected for presentation to the Asiatic Society, Universities of Cambridge and Oxford and the East India Company. The major portion of the library, however, was transferred to Calcutta, for the instruction of the Company's employees in the Sciences of Europe and Asiatic languages.

A descriptive catalogue of this collection, "The Oriental Library of Tippoo Sultan" was prepared by Charles Stewart, Professor of Oriental Languages at Hertford College, and printed at the Cambridge University Press in 1809.

According to this author, the library of Tippoo Sultan consisted of nearly 2,000 volumes in Arabic, Persian and Hindustani. Many of the manuscripts were beautifully written and artistically bound, but a great many had unfortunately lost the first and the last pages, making it extremely difficult to discover the author or the period in which they were composed. One would like to know whether there were similar books and manuscripts in the European languages and if so, where they are today.

Professor Stewart writes that they were part of the acquisitions by Tippoo's illustrious father. "Some of them had formerly belonged to the Mohammadan Kings of

Bijapur and Golconda. But the greater number had been the property of Nawab Nasir Addowlah Abd el Vahib Khan, brother of Mohammad Ali of Carnatic and were taken by Hyder in the Fort of Chittor during 1780."

The Arabic books, forming less than a quarter, consist of the standard works of Al Razes, Avicenna, etc. The descriptive catalogue of Oriental books contains 2 lists of medical books (68 in all): (1) The section entitled "Physic books, Persian"; (2) "Arabic Books". Nearly three-fourths of the books are in Persian. They are the more important, as some of them belong to the early part of the 12th and the 13th centuries, and emanated from the great centres of culture such as Khwarizm, Jorjanny, Khorassan, Bokkharah, Shiraz, etc.

Besides many old and authoritative works on Medicine copied from Persia and Turkestan, there are also some treatises which the Persian and Turkish Physicians wrote in India, under the patronage of the Indian Rulers. No. 4 in the section of Persian Medical treatises, is a book on "Gynecology and Pediatrics", written by Mansur Mahommad, and dedicated to Sikander Shah II, of 'Dhely'—round about 1300 A.D.

No. 9 is called "Mine of Remedies", written by Bava Bhauz Khan. The date is given as 1512, and the book is said to be dedicated to Sikander Shah of Dhely. (The book itself must be re-examined to check these points.)

No. 18 is *Tibbi Akbari* (translation of the Arabic work); No. 19, *Tyurribati Akbari* is a work on physic and personal hygiene; No. 20, *Corababini Cadurv.* contains the Pharmacopœia of Hindustan. All the three books (Nos. 18, 19, 20) were composed by Mohammad Akbar Arziny, Physician to Emperor Aurangazeb, to whom they are dedicated.

No. 21 is a treatise on Medicine, Food and Clothes, by Mohammad Riza and dedicated to Emperor Aurangazeb.

Next, we may mention a few books, important for the history of Medicine in Madras. No. 24 is a treatise on Diseases, composed in 1747; No. 25 is an appendix to the above; No. 26 is a treatise, giving the

* In commemoration of the 150th Anniversary of the great Tippoo Sultan of Mysore.

Pharmacopœia of Medicines used in Carnatic and compiled in 1751 A.D. The author of these three books was Sekunder Ben Ismail of Constantinople, Physician to the Nawab Mohammad Aly Khan of Arcot, to whom the books are dedicated.

Lastly, books written under the direction of Tippoo Sultan himself are very interesting and instructive (Cat. page 113). These are important for the history of Medicine in Mysore. Some of them are in the traditional or orthodox style.

No. 42, *Bihral Munafi* (The Sea of Profit) is a treatise on midwifery, treatment of children, enchantments, exorcisms of devils, etc., by Mulud Mohammad, dedicated to Tippoo Sultan (1794 A.D.).

No. 43 is a general treatise on Medicine, alphabetically arranged, composed by Mohammad Nasir Afshar Turk and dedicated to Tippoo Sultan.

Other volumes illustrate the new trends and influences. Besides, they clearly establish the fact that contrary to the prejudiced reports of European historians, Tippoo was very progressive in his outlook and views, and encouraged the study of the European literature on Medicine, trickling in slowly through the trader, the diplomat and the doctor. Knowledge and particularly Medical Science, was liberally patronised and actively encouraged by him, irrespective of its source or country; the knowledge itself was freely incorporated and utilised for the benefit of the people. This laudable spirit of Tippoo Sultan is amply borne out by the following works:

No. 44. *Kanun Der Ilmi Tibb*. A translation of the complete London Dispensatory: The date and the name of the translator are not given. The translator says in his preface that this work is the result of the united efforts of all the learned (physicians) of Europe and translated by the Order of Tippoo Sultan;

No. 45. *Terjumeah Ketabi Angriz*. (Translation of the English treatise on Electrical and Medical Experiments);

No. 46. *Turjumah Ketabi Freng*. (Translation of Dr. Cochrane's treatise on "Twist of the Intestines".)

In addition to these books in the section on Physic, there is, in the section on Arts and Sciences, a book, No. 9 (page 97 of the Cat.) called "A Treatise on Botany and Natural History" translated by the Order of Tippoo Sultan from French and English books. It has good etchings of plants.

The Unknown Authors.—In a footnote (p. 97) Professor Stewart says, "It appears that Tippoo Sultan was an encourager and patron of the Arts and it is stated that 45 books on different sciences were either compiled or translated from different languages under his immediate inspection or auspices. It is probable that some of our unfortunate countrymen, who were so long detained in captivity and had thereby acquired a knowledge of the Dekkani languages assisted him in these pursuits". It is also possible that there were some Europeans in his employ as personal physicians and surgeons, who were encouraged to do literary work under the patronage of the Sultan.

A SOUTH SEAS OBSERVATORY

THE Bosscha Sterrewacht Observatory at Lembang in Indonesia, which was seriously damaged during the war, is to receive material assistance organized by UNESCO.

American and Dutch astronomers are collaborating to ensure the construction of a new type of astronomical telescope, consisting of two minors, one of them 3 ft. in diameter.

The Bosscha Observatory is situated in what the famous astronomer Dr. Gerard P. Kuiper of the University of Chicago Yerkey's Observatory describes as "one of the most beautiful spots on earth".

The opportunities for good research work

at this observatory are great, because of its favourable location 7° south of the Equator, which makes the southern stars visible; and its adequate elevation, 4,200 ft., which ensures a good climate.

The observatory was heavily damaged during the war and the young Director and his two assistants died at the hands of the Japanese. Chicago University and Yerkey Observatory, the University of Leiden, Holland, the University of Louvain, Belgium, and Unesco are shortly to sign an agreement whereby this Far East observatory will receive help, and thus be able to play an important part in advancing astronomical knowledge. (Courtesy of *Courier*, UNESCO, 1-11-1949.)

PROTEIN HYDROLYSATES FOR THE MICRO-BIOLOGICAL ASSAY OF AMINO-ACIDS*

R. RAM MOHAN, K. C. THADHANI, V. S. GOVINDARAJAN AND M. SREENIVASAYA

(Section of Fermentation Technology, Indian Institute of Science, Bangalore 3)

THE circumstance that certain amino acids in a protein hydrolysate can be selectively and quantitatively removed or destroyed, offers the attractive possibility of employing such hydrolysates in the microbiological assay of some amino acids. For tryptophane assay for example, Green and Black¹ have used an acid hydrolysate of casein; Lyman² has used H₂O₂ treated peptone for methionine assays. In the course of nutrition studies, protein hydrolysates have been widely employed from which a given essential amino acid is eliminated by suitable treatment. Wood, *et al.*³ have used freshly prepared Raney's nickel for the removal of organic sulphur from sulphur containing amino acids from a protein hydrolysate. Ion-exchange resins have been used by Sperber,⁴ and Cannan⁵ for the removal of di-carboxylic and the basic amino acids. Lewis,⁶ *et al.* have removed glutamic acid quantitatively from casein hydrolysate as pyrrolidonecarboxylic acid.

Experimental

Acid hydrolysate of casein was prepared by the method of Snell and Wright⁷ and alkali hydrolysate was prepared using barium hydroxide which is quantitatively removable as sulphate. Acid hydrolysates, after supplementing with cystine, methionine, and fortification with vitamins, purine bases, salts, sodium acetate and glucose, have been found useful for tryptophane assays. Similarly alkali hydrolysates fortified with methionine, and arginine or cystine, have been found suitable for the assay of cystine and arginine respectively.

The pre-treated hydrolysates, before actual use, were tested for their freedom from a given amino acid by chromatographing the liquid on paper using the capillary ascent test tube method developed by Rockland and Dunn⁸ with *n*-butanal-acetic acid as developing solvent. What is

shown to be absent by this test has been found to reach the microbiological standard of purity, as can be seen by Table I.

TABLE I

Treatment of casein	Amino acid removed	Chromatogram test	Microbiological test
Acid hydrolysis	Tryptophane	Spot absent	Absent
Acid hydrolysis and H ₂ O ₂	Tryptophane	Spot absent	Absent
	Methionine	Intensity of Valine-Methionine spot reduced to half	Absent
Alkali hydrolysis	Cystine	Intensity and diameter of basic amino acid spot is less than control	Both absent
	Arginine		

Media for the assay of tryptophane, methionine, cystine and arginine:—

	Tryptophane	Methionine	Arginine	Cystine
Basal medium 15 ml. each (composed of all vitamins, purine bases, salts and sugar)	..	+	+	+
Acid hydrolysate of casein	..	+	+	+
Alkali hydrolysate of casein	..	+	+	+
H ₂ O ₂ treated acid hydrolysate of casein	..	+	+	+
Tryptophane	..	+	+	+
Methionine	..	+	+	+
Arginine	..	+	+	+
Cystine	..	+	+	+

Volume was made up to 50 ml. in each case, and the pH of the media adjusted to 7.2.

1.5 ml. of the double concentration medium was transferred to 4 ml. capacity pyrex tubes (4" × 1/2") and graded doses of tryptophane, methionine, cystine or arginine as the case may be were added and the volume in each tube made up to 3 ml. by adding the requisite quantity of distilled water. The tubes were steam sterilised for half an hour, cooled and inoculated with the thrice washed saline suspension of the test organisms. After 72 hours of

* Presented at the Symposium on 'Microbiological Assay of Amino Acids, Vitamins and Other Growth Factors' held on 17th December 1949 at the Indian Institute of Science, Bangalore, under the auspices of the National Collection of Type Cultures, India, and the Society of Fermentation Technologists, India.

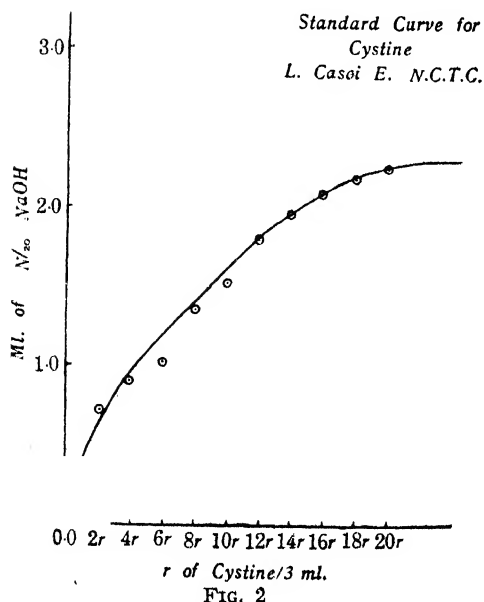
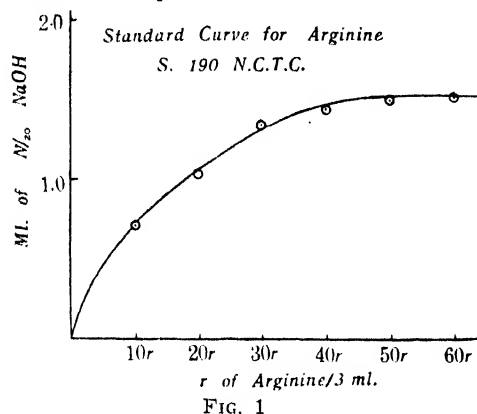
incubation at 37° C. the entire quantity was titrated against N/20 NaOH. The results are graphically illustrated.

Amino acid	Organism	Range	Remarks
Tryptophane	<i>L. arabinosus</i> , NCTC 2161	0.0-2.0y	Ideal
Methionine	<i>Leuconostoc mesenteroides</i> P-60 NCTC 2177	0.0-15.0y	Ideal
Arginine	S-190, NCTC 2185	0.0-50.0y	Ideal
Cystine	<i>L. Casei</i> E, NCTC 2153	0.0-20.0y	Ideal

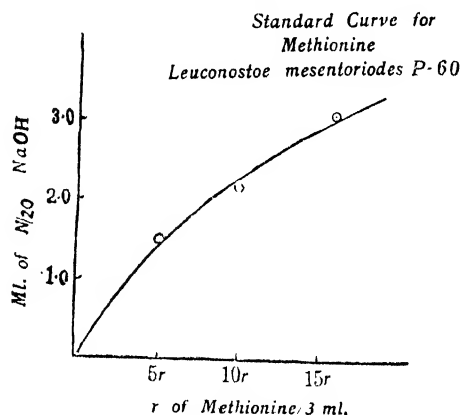
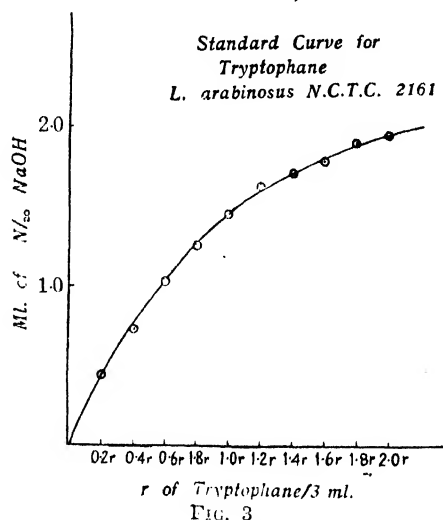
Discussion

The pre-treated hydrolysate provides a simple, inexpensive and well-balanced mixture which can safely replace the usual medium compounded from individual

be minimised for most of the assays. These pretreated casein hydrolysates have been utilised for obtaining the standard curves for arginine, cystine, methionine and tryptophane (see Figs. 1-4) and are now



amino acids. The use of expensive amino-acids which are now difficult to import can



being extensively employed in our laboratories for the routine assay of these amino acids in biological materials.

Our grateful thanks are due to Dr. N. N. De, for certain facilities extended to us and to the Council of Scientific and Industrial Research for their generous financial support.

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SPECIAL LIBRARY SERVICE

ALTHOUGH, by definition, a special library is a special collection of books serving a special clientèle and using special methods for the purpose, it may assume an importance not less than that of general libraries which in size may be much bigger.

In recognition of its importance, the Indian Library Conference, at its session held in 1946 at Baroda, passed a resolution favouring the establishment of a special libraries section as an indispensable wing of the Indian Library Association, with a view to meet the increasing demand on the libraries in India, following the move for the rapid industrialisation of the country.

It is gratifying to record that a special library service has already been started at the Library of the Indian Institute of Science, Bangalore, which has been building up special sub-libraries devoted to particular subjects like Aeronautics, Metallurgy, Internal Combustion Engineering, High Voltage Engineering, Chemical Engineering, the Social Sciences, and Economics. The sub-library being the nucleus round which the special library has to evolve, there is every reason to hope that before long there will be special libraries relating to all important subjects in pure and applied sciences, at this centre.

It is a hopeful sign that the Indian Library Association has already appointed an *ad hoc* committee to go into the question of special libraries. Most of the members in question are themselves in charge of libraries devoted to specialised fields such as agriculture, irrigation, science and technology. An annotated guide-list of special libraries in this country was first published in the Oct.-Dec. 1941 issue of the *Modern Librarian*. It shows that there are already in this country libraries attached to special fields

such as public health and hygiene, chemical technology, industries, railways, forestry, geology, medicine, serology, dairying, veterinary sciences, architecture, commerce, meteorology, statistics, banking, botany, zoology, tropical medicine, indology and Indian culture. Libraries devoted to textiles and food technology have recently been started at Ahmedabad and Mysore. More libraries are coming into existence at all research centres like Poona, Bombay, Calcutta, Jamshedpur, Dhanbad, Delhi, Madras, Roorkee and Karaikudi. Besides these there are at least three information bureaux functioning now at Kanpur, Delhi and Bangalore, while there are indications that more will be started in the near future.

With these developments coming into being, more librarians with experience in special and technical fields will be called upon to organise and man them. Naturally, this brings to the foreground the question of special library training, which is indispensable, and which can be most profitably achieved by the system of taking in scientifically qualified students for library training, and then as apprentices in special libraries for a period of intensive training in special fields under expert guidance.

In conclusion we may observe that while a beginning has been made to realise the importance of special libraries, needed for the industrial and scientific advancement of our country, there are problems connected with it which can only be solved if they are tackled with a sense of urgency by an organisation exclusively devoted to the promotion of the special library movement in India.

G. T. KALE.

TRIALS, DUTIES AND REWARDS

STANDING on the threshold of a new era, India faces today great trials, great duties and great rewards. The precious gains towards which we may hope to progress is in the development of our industries, agriculture, scientific research, transport, defence, public health, education and other creative endeavours, which contribute to the strength and well-being of the country. In the trials and in the duties essential to that progress, we the scientists

and technologists of the country, in our infinitely varied types, have to play our rightful part and bear our full share. Indeed, ours is a responsibility unequalled by that of any other section of the people. To enable us to discharge this responsibility, it behoves the State to create the necessary conditions in the coming years.

—SIR S. S. BHATNAGAR,

SCIENCE AND THEOSOPHY*

THE four volumes under the suggestive and comprehensive title "Where Theosophy and Science Meet" edited by D. D. Kanga had been noticed from time to time in the columns of the *Current Science*, and the volume under notice that has been published as No. 21 of the Adyar Library Series constitutes a revised, reset, and enlarged edition of the previous volumes of which two are here presented, the other two being reserved for a second volume. Part the first under the title "Nature" describes or traces the movement from "Macrocosm to Microcosm", and the second part entitled "Man" sketches the progress from "Atom to Man". Within the limits of a critical review, it is neither possible nor desirable to undertake any detailed examination of the doctrines and theories expressed in the volume, and the facts and data on which these peradventure rest, that do not and would not admit of any laboratory testing under controlled conditions through the instrumentality of qualitative and quantitative analysis. Let me, therefore, direct my attention to the general lead given in the "Introduction" to the revised edition.

There is the inevitable reference to chaos and conflicts in the world and to the Atomic weapons of destruction. What is the diagnosis? All the troubles are due to "fundamental maladjustments which are due to lack of perception of the essential values of life". The author illustrates the maladjustment by reference to a correlation effected between *Body* of Man and Economics and Politics, *Mind* of Man and Science and Engineering, and the *Spirit* of Man and Ethics and Spirituality. Further elaborating the nature and characteristics of such a maladjustment, he points out that while the sciences and disciplines correlated with *Body* and *Mind* seem to be moving pretty fast, those connected with the *Spirit* move slowly with snail-pace.

What is the remedy or the prophylactic? It is suggested that World-order, Social-order, Governments *et hoc* should be reconditioned and readjusted on the basis of absolute primacy and pre-eminence assigned to Ethics and Spirituality correlated with the *Spirit*. *Mind* and its correlates would rank next. At the lowest rung of the ladder of the New Civi-

lization would stand *Body* with its correlates of economics and politics. The New Order must be built on the bed-rock of "right triune concept of man".

It has become an alarmingly infectious fashion nowadays for intellectuals di-thyrambically to complain of maladjustments brought about by modern civilization and conditions of living grounded on the discoveries and inventions made possible by the advancement and progress of different positive laboratory sciences, but, whether a phenomenon like the World-Armageddon I or II is to be regarded as an adjustment or a maladjustment must depend in the last and final analysis on the definition of adjustment and maladjustment one may arrive at or formulate. When the reign of relativity is supreme, it will be always possible to argue that what is termed maladjustment from one stand-point may be really adjustment from another. The analogy pressed into service in the Gita must be of striking help. What the common folk including our best economists and politicians and so-called world-figures and personalities, leaders of world-thought and energisers of world-action regard as waking life and broad daylight, is really night to a genuine seer or saint. Likewise when the genuine seer or saint enjoys daylight, the common folk are in deep sleep immersed in cymmrian darkness (*Yanisa-sarvabhootanam...*, Gita, 2-69). What the Lord wills on a cosmic scale cannot be a maladjustment in biological or sociological connotation. This apart, is the author's diagnosis correct? Is the prophylactic proposed effective?

As far as I can see, the diagnosis to the effect that modern civilization grounded on science and scientific values stands maladjusted on account of its failure to have regulated life in the light of Ethics and Spirituality does not seem to be correct. For, one cannot convert mankind overnight into saints and spiritualists. Even in the maladjusted age, Ethics and Spirituality are bound to appeal to a small, microscopic minority. Such an appeal has elicited responses and aspirants patterned that way are even to-day leading higher life the details of which would never get into newspaper columns. When there is no demand, there is no supply. This rule of economics would apply to the economics of higher life as well. Throughout the world, the demand for Ethics and Spirituality is scanty, and you can-

* *Where Theosophy and Science Meet*. Vol. I. Edited by D. D. Kanga, I.E.S. (Retd.), The Adyar Library Association. Adyar, Madras. Pp. liv x 418, Price Rs. 9,

not describe that as a maladjustment. If, with eyes wide open, individuals, communities and nations mould their conduct on the motto "Evil! Be Thou My Good", urged on by the potential of their past *Karma*, such behaviorism or meta-behaviorism as American Psychologists would have it cannot be described as maladjustment.

If, as I feel, the diagnosis is incorrect, the remedy, I am afraid may not be effective. (I had almost typed quack-remedy—as suggested by Leonard Wolfe's "Quack-Quack".) It is so easy to talk of Ethics and Spirituality. All the world-teachers have done that. Notwithstanding the appearance on the world-stage of Christ, Buddha, Krishna, and others, and the prevalence of their teachings and doctrines, you hear the loudest of complaints that science and science-built civilization have hurled the world into the abyss of maladjustment. What Srijiut Kanga and other good, and well-intentioned souls miss is the solid and stubborn fact that Ethics and Spirituality cannot be patented into powders and pills and administered to war-mongers and world-monopolists and cosmic capitalists. They are all urged by their self conditioned by *Prakriti* (*Prakritim-yantibhootani...*, Gita, 3-33). Patented peace-pills now sought to be sold by the UNO, UNESCO and other world-organizations may find salesmen and saleswomen, but, they would have little or no effect on the patients themselves.

I hasten to submit that I have no desire either to belittle or underrate the value and significance of the magnificent work in the direction of humanization and spiritualization of mankind that is being attempted by Srijiut Kanga and others who have collaborated and co-operated with him. Nevertheless, in the interests of impartial and disinterested research and investigation it must be pointed out that a mere academic call to ethicize and spiritualize behaviorism will never be competent or sufficient to save mankind.

With many other *dicta* or *obiter dicta* of the author of the "General Introduction" it is impossible to agree. For instance, it is said that "The present is a mind-dominated world". It is *not*. It is throughout dominated by mind, body, and spirit, *tria juncta in uno*. Those who are at the helm of national and international affairs to-day are guided and dominated by a particular pattern of mind, body and spirit. You may discern direst disaster in the pursuit of the pattern. Whatever the condition in Western Psychology, in Indian Psychology intellect, emotion and will,

the cognitive, the emotive, and the conative are *never* separated from one another. A "pure" and "unconditioned mind" is of no use in solving the problems of war and peace, because, when *unconditioned*, as in strict Vedantic connotation, the mind becomes or gets centred on eternal verities that bear no relation to the myriad-faced and hideous hedonisms of economics and politics.

It is neither here nor there. The problem posed by Sankara, to mention but a single classic instance, is still awaiting solution. In describing the affairs and concerns of the world, Sankara has used two key-terms. They are "Anartha" and "Prahana". The world and its affairs (*Lokavyavahara*) are *not* yet evaluated as demanded by the Acharya. They involve, one in colossal disaster. The root-cause of that disaster must be eradicated. The indispensable preliminary to all spiritual outlook is the sharp and poignant perception that the values of the world, economic, political, etc., must be superseded and transcended (*Prasankhyana*, as Vachaspathi Misra puts it with unerring and downright effect).

Does Theosophy counsel such a course? Perhaps it does. If so, I can categorically assert there is *no need* for Theosophy to meet Science at all. There is a section in the volume on "Scientific corroborations of Theosophy". I would like to question—who is so anxious to get such corroboration? For whose benefit do Science and Theosophy meet? Is it for the benefit of modern Science? Arrogant and supercilious modern Science that has been responsible for the Atom-Bomb is *not* anxious as far as I can see, or as far as collective judgment of the Scientists itself would indicate. Or, is it for the benefit of Theosophy? A Theosophy that stands in need of corroboration from laboratory sciences that are *per se* incompetent to deal with such subject-matter as God, Transmigration, Karma and so forth has to be pronounced nervous and lacking in self-confidence. They may after all meet as the *Prakriti* and *Purusha* of the San'hya system are reported to have met. But, nothing would come out of the meeting that must eternally remain barren.

I carefully note what is said about the "True Democratic Way of Life", but, the expression is as good or as bad as *Rama-Rajya* about which so much noise is being made just now. With India (*Bharatavarsha*) politically and territorially cut or dichotomized into *two*, with ubiquitous, obnoxious controls of all necessities of life, with ominous food and cloth scarcity, with communistic and communalistic

troubles here, there, and everywhere, if under the urge of political sentimentalism, one were to claim that we are now living in *Rama-Rajya*, such a person must be dismissed as *non compos mentis*. The so-called True Democratic Way of Life seems to me to be neither True, nor Democratic, nor even a way of life, because, behind a facile and ringing terminology, no Reality is discernible. Paradoxically enough, one can talk of a True Democratic Life only when the values of life including political democracy and self-government, which certainly is no substitute for good government, are subjected to rigorous transvaluation on the criterion pointed out by Sankara and the great Acharyas. I am feeling guilty of having exceeded the space-limit set by the learned and talented Editor of *Current Science*. I shall conclude the notice with only one more observation.

Great stress is laid on what is called the "Occult Method," the "Occult Science" and so forth including "Occult Chemistry". The occult method may not differ from the elaborate and complicated methodology developed by Patanjali's Yoga-Darsana. Here again, it is impossible to hide or forget the fact that the occult method has not been used by any to relieve global distress and unrest. This is claimed to be supplementary to the scientific method and also superior to it. Its superiority

is yet to be demonstrated under controlled conditions. Neither the methodology of Yoga nor the occult method can be universalised for global consumption on a mass-scale.

Prof. Kanga and the monographists that figure in the volume must have the heartiest felicitations of the thinking section of humanity. The volume is stimulating and challenging. Prof. Kanga's narration of the story of the Atomic Bomb is really romantic and thrilling. When all is said and done, *Theosophy* should grow more and more *theosophical*. *Science* should grow more and more *scientific*. Neither should coquette with the other. The result of such coquetting would be final meeting in the Divorce Court on the supremest ground of temperamental incompatibilities. The Atomic Bomb is not a challenge to Man. It is a challenge from a man of some knowledge to another who is ignorant of the Uranium-transaction. A distracted author from America asks—Can Psychology save modern Civilization? (*New Frontiers of Psychology*—Nicholas deVore—Philosophical Library—New York). Readers are bound to ask—Can Theosophy and the Occult method save mankind and its civilization? For answer please see page 214 of the volume. P. 204 contains a misprint (Sanskrit text).

R. NAGA RAJA SARMA.

BUILDING RESEARCH IN INDIA

A BUILDING RESEARCH UNIT was set up at Roorkee in 1947 to deal with problems such as construction of low-cost houses and utilisation of cheap construction materials. It is proposed to extend the activities of this unit and establish a Central Building Research Institute at Roorkee.

When the Institute starts working in full swing, the major Divisions would be further divided into sections to deal with subjects such as: (i) Studies on Pozzolanic Material, (ii) Preservation of Stones, (iii) Studies on Paints and Varnishes in relation to Building Materials, (iv) Ceramics and Heavy Clay Products in relation to Building Requirements (v) Studies on Soils, (vi) Studies on Corrosion of Metals used in the Building Industry, (vii) Studies on Fire Resistance Properties of Building Materials, (viii) Structural Acoustics, (ix) Physiological Studies on Inhabitants in Tropical Climate (x) Studies on Foundation Problems, etc.

There will also be an Intelligence Section in the Institute whose functions would be (i) collection of available information on the subject (ii) translation and co-relation (iii) dissemination.

The Central Building Research Institute will also have as one of its functions the co-ordination of all the work done on Building Research in the country besides the other functions already pointed out.

The Physico-Chemical Laboratories of the Unit are fairly well equipped. Some of the engineering testing equipment is also available and heavier testing equipment worth £1,300 has been ordered from abroad. The Library attached is well stocked with the latest volumes on important subjects, and subscribes to all topical Journals, besides posting itself with the latest technical bulletins and publications of kindred research stations in other part of the world.

MODERN SYNTHETIC RUBBERS*

THE development of Synthetic Rubber is one of the greatest achievements of chemical industry. Originally limited only to the very narrow field of rubber manufacture, synthetic rubber is now challenging, more and more, many of the domains in which natural rubber once reigned supreme. By 1948, capacity for production of synthetic rubber reached 1.2 million tons in U.S.A.

The author of the treatise under notice has discussed the question of raw material for the production of synthetic rubber at considerable length in Chapters VI and VII. Butadiene, by far the most important ingredient of a synthetic rubber molecule, is produced from alcohol by the Levedov process. The Russians obtained alcohol from potatoes and the Americans from grain; it is now obtained from ethylene which is present in the tail gases of petroleum refineries. The Germans concentrated on the use of acetylene obtained from calcium carbide as their principal raw material, and butadiene was obtained from acetylene, through aldol condensation of acetaldehyde.

The last three chapters of Part II form an interesting review of the various methods of polymerisation with particular reference to the manufacture of synthetic elastomers. But the paragraph on the mechanism of polymerisation at the end of Chapter VIII is too short. A little more information regarding the actual mechanism involved would have given it the completeness which it lacks at present.

The chapter on compounding in Part III of the book attempts to give too much information in too little space with the result that clarity suffers.

A good account is given, however, of the compounding and processing of various elastomers and of the properties of their vulcanisates in the chapters dealing with each individual elastomer. The manufacturing details of GR-S and Buna-S are also included.

Unlike natural rubber, unloaded GR-S compounds show inferior physical properties. Carbon black is absolutely essential in order to bring out the best characteristics of GR-S. The use of specially prepared furnace blacks for the reinforcement of GR-S in preference to channel black used for natural rubber opened a new chapter in the manufacture of rubber

grade carbon black. Although furnace black of the type of Kosmos is most suitable for good tensile properties of GR-S, lamp black has been found to be more advantageous for applications requiring high resilience. This is not explicitly stated in Chapter XIII, but a passing reference is made to the behaviour of lamp black in GR-S.

The fact that due to certain outstanding properties such as resistance to solvent action, gas permeability and fire, synthetic elastomers like Perbunan, Butyl rubber and Neoprene have come to stay in the field of rubber technology is clearly brought out.

The chemistry of synthetic rubbers is so closely related to that of plastics that sometimes it becomes difficult to say whether a product is a synthetic rubber or a plastic. Silicone is a typical example. Incidentally, it may be noted that no mention of this polymer is made by Barron in his book. Chapter XX is devoted to Polyvinyl plastics, mixtures of Perbunan and Polyvinyl chloride compounds, flex, tear and ozone resistance.

The new class of compounds 'Lactoprenes' serves as an indication that there are still possibilities of new synthetic elastomers being produced.

The last chapter where the properties of different elastomers are compared is very valuable for purposes of reference.

In the section on molecular weight of rubber (Chapter V), there is no reference to the recent work on molecular weight determinations of rubber. This is especially surprising. Also, there is no mention of 'Cold rubber' which is the latest version of GR-S, and which has been reported to compare very favourably with natural rubber.

On page 271, accelerators are defined as chemical compounds which 'hasten the rate of vulcanisation'. This reduction in time of vulcanisation is only one of the functions of an accelerator. The majority of accelerators profoundly influence the properties of the resulting vulcanisates. The statement in Chapter XI that in compounding the main object is 'to reduce costs without sacrificing quality' is open to question.

These are points which can be overlooked. The book is a valuable contribution to the literature on synthetic rubbers, and may be read with profit.

J. C. GHOSH.

* "Modern Synthetic Rubbers." (Chapman and Hall, 1949; pp. xix + 636. 45 sh.)

MICROBIOLOGICAL ASSAYS

UNDER the auspices of the National Collection of Types Cultures, India, and the Society of Fermentation Technologists, a symposium on the "microbiological assay of amino acids, vitamins and other growth factors" was held on Saturday, the 17th December 1949, at the Indian Institute of Science, Bangalore. Dr. N. N. De, Assistant Professor of Pharmacology, presided on the occasion. The isolation and characterisation of micro-organisms from various sources and the factors which influence the choice of these organisms for purposes of assay, were described in considerable detail. The importance and need of a continued search for new and better organisms which, (1) can utilise bound forms of growth factors; (2) can be employed for the assay of "strategically important" peptides; (3) are more specific to the given constituent and less susceptible to interfering substances associated with natural extracts; and (4) are characterised by a higher stability and reproducibility of performance were stressed during the discussion.

A paper on the preparation of samples for assay discussed the relative merits of acids, alkalies and enzymes as hydrolysing agents. It was pointed out during discussion that the enzymatic hydrolysis of samples should

be studied in greater detail to avoid the serious shortcomings of acid and alkali hydrolysates. In a paper on analytical methods employed, it was pointed out that counting of cells of the test organism in a drop of the assay medium can be adapted for estimating ultra-micro quantities of growth factors. An interesting and valuable paper explained the use of treated protein hydrolysates (a paper appearing elsewhere in this issue) as a substitute for mixtures of pure and expensive amino acids, now difficult to get. A description of the paper-strip chromatography technique to check the freedom of the treated casein hydrolysates from particular amino acids, was given. It was shown that the method is highly sensitive and is capable of establishing microbiological standards of purity. Following a paper on the "use of test organisms in the discovery of new factors", detailed papers on the organisms available for assay of amino acids and vitamins in the National Collection of Type Cultures, India (sponsored by the Council of Scientific and Industrial Research), were presented. The last paper dealt with the assay of trace elements and minor growth factors.

V. S. G.

TRIPS TO THE MOON BY 1960*

NEWSPAPERS of late have been full of contemplated trips to the moon. One scientist at Frankfurt, Germany, Dr. Heinz Gartmann, has been quoted as saying, "All we need now is the chance—and the financial aid—to put our theories into practice." It is stated that half the battle, the completion of basic theoretical calculations for the design of the moon rocket, has been won.

On this side of the ocean considerable publicity has come to members of the Canadian Rocket Society at Toronto. Captain E. J. Evans Fox, visiting New York, displayed a blueprint for a 200-foot-long craft driven by nuclear fission with tripod takeoff and landing equipment. He plans the moon as only a stopover point, and revives the economical year and a half Mars-Venus tour that was long ago designated the Hohmann Round Trip (see *Rockets*, Willy Ley, 1944). Captain Fox does not worry about the water and oxygen supply for his passengers, indicating that processes are already in use for the re-

covery of both of these from the products of combustion. And as for food, he says there is room for tons of it. We tend to be skeptical; but Boris Dyke, Vice-President of the Canadian Rocket Society, comes into the limelight with more data and even a prediction. In charge of the planning, he is quoted as saying that 1960 is not only a plausible date but the one toward which they are working for their trip to the moon.

While the most time-saving trip would require only 15 hours, plans are for a four-days-each-way trip in an elliptical orbit which would require less fuel by taking advantage of natural gravitational fields. The 1,000 ton ship would itself cost only about five million dollars; but Dyke estimates that hundreds of millions of dollars will first have to be spent on preliminary research and trials.

* By courtesy of *Sky and Telescope*, 1949, 9, 10.

LETTERS TO THE EDITOR

	PAGE		PAGE
Note on a Correction by Laporte to Ostrofsky's Formulæ. V. RAMAKRISHNA RAO.	435	The Effect of Water-Logging on the Chemistry of Sugarcane Juice. K. L. KHANNA AND A. S. CHACRAVARTI	443
Elastic Constants of Lithium Fluoride. T. SESHAGIRI RAO	436	A New Synthesis of 4-Hydroxy-2-Phenyl-3-Acetylquinoline. S. A. KULKARNI, V. M. THAKOR AND R. C. SHAH	444
Raman Spectrum of Methyl Methacrylate Glass. M. M. PATEL.	436	On the Biological Control of Striga Species. P. UTTAMAN	445
Spectrum of Monobromobenzene. K. SREE-Lake near Jubbulpore. H. L. CHHIBBER	437	Mound Forming Termites and their Control. P. J. DEORAS	445
Geographical Investigation of the Gokulpur Lake near Jubbulpore. H. L. CHHIBBER	437	The Influence of Available Carbohydrates upon Ammonia Accumulation by Penicillium notatum Westl. B. S. MEHROTRA	446
On Organic Remains from the Vindhya (Pre-Cambrian). R. C. MISRA	438	The Megastrobilus of Nipanioruha granthia Rao A. R. A. R. RAO	447
Influence of Vitamin C on Phosphorylase. J. SRI RAM AND K. V. GIRI	440	Sagitta bombayensis, Lele and Gae—a Synonym of Sagitta robusta Doncaster—with a record of Sagitta pulchra Doncaster, from Indian Coastal Waters. P. C. GEORGE	448
Synthesis of Saccharin from Anthranilic Acid. N. B. DALAL AND R. C. SHAH	440	The Laticiferous System of Regnellidium diphyllum Lind. T. S. MAHABALE	449
Chemical Structure of the Condensation Product of Formaldehyde with Sulphathiazole. V. V. NADKARNY, S. S. BHATNAGAR, A. N. KOTHARE AND F. FERNANDES	441	Indicators in Chemistry, M. VENKATARAMANIAN AND B. H. S. V. RAGHAVA RAO	450
Friedel-Crafts Acylation of Methyl β -Resorcyate: a new and convenient Synthesis of 2-Acetylresorcinol. P. L. THRIVEDI AND SURESH SETHNA	442	Chemical Examination of the Seeds of Luffa graveolens Roxb. and Luffa echinata Roxb. RAM GHULAM SINGH NIGAM, K. C. PANDYA, AND JAGAT NARAYAN TAYAL	451
Occurrence of Fungi inside Rice Kernels. S. Y. PADMANABHAN	442		

NOTE ON A CORRECTION BY LAPORTE TO OSTROFSKY'S FORMULAE

SINCE the completion of our work (1948) on the term values in the complex spectra of Cb I and Cb II, we noticed that Laporte (1942) had found discrepancies in the values given by Ostrofsky for the term values in d^4 configuration. He recalculated and obtained for the individual values of the term pairs $^1S_{\pm}$ and $^1G_{\pm}$ the following correct formulæ:

$$^1G_{\pm} = 6F_0 - 5F_2 - 6.5F_4 \pm \frac{1}{2}(708 F_2^2 - 7500 F_2F_4 + 30825 F_4^2)^{\frac{1}{2}}$$

$$^1S_{\pm} = 6F_0 + 10F_2 + 6F_4 \pm \frac{1}{2}(3088 F_2^2 - 26400 F_2F_4 + 133200 F_4^2)^{\frac{1}{2}}$$

The error in Ostrofsky's values is just in the coefficient of F_2F_4 —(Ostrofsky's values being 6420 and 21340 respectively for 1G and 1S). The formulæ derived by the author (1948) for d^4 configuration which were originally based on Ostrofsky's values need slight modification on account of this change. But the values of the parameters as determined by us previously in both cases are not affected, as in the calculation of them the values of such high terms as 1G and 1S were not used. The mean values, too, are not affected. The slight effect is only on the calculated individual values of the terms in each pair. The percentage error in such cases is also

very small as can be seen below from a calculation for the two 1G 's.

	Ostrowsky	Laporte	Difference	Per cent
Mean value	20126.5	20126.5	0	0
${}^1G_+$	25490.2	24526.5	+963.7	4
${}^1G_-$	14762.8	15726.5	-963.7	

The error is about 4 per cent. This is practically negligible. Hence calculations for the other pair are not made. But it might be noted that in all future calculations Laporte's formulæ might be used. The formulæ given by the author for d 's also might be modified accordingly.

Andhra University, V. RAMAKRISHNA RAO.
Waltair,
September 20, 1949.

1. Laporte Otto, *Phy. Rev.*, 1942, **61**, 302, 305.
2. Ostrowsky, *Ibid.*, 1934, **46**, 604.
3. Ramakrishna Rao, V., *Ind. J. Phys.*, 1948, **22**, 429.

ELASTIC CONSTANTS OF LITHIUM FLUORIDE

LITHIUM FLUORIDE is an ionic cubic crystal but its elastic constants as determined by Schæfer and Bergmann (1938), do not satisfy Cauchy's relation $C_{12} = C_{44}$. Sundara Rao (1949) has recently found better agreement but even according to him, C_{12} and C_{44} differ by as much as 16%. An exceptionally clear and artificially grown crystal was put at my disposal by Prof. Bhagavantam and it was thought desirable to repeat the measurements.

Sections (001) and (011) of different thicknesses (1.790 to 1.983 mm.) have been cut from this sample and used. Ultrasonic velocities in these plates are determined by the wedge method, using frequencies in the range 1 to 12 mc./sec. and the elastic constants are evaluated in the usual manner. The density of the substance as determined by the author is 2.635 gm./cm.³, and agrees well with the average value 2.640 given in Landolt-Börnstein Tables (1927). The bulk modulus K along with the elastic constants (10^{11} dynes/cm.²) and the elastic coefficients (10^{-13} cm.²/dyne) are given below.

No.	Observer	C_{11}	C_{12}	C_{44}	S_{11}	S_{12}	S_{44}	K
1	Schæfer & Bergmann	11.8	4.34	6.28	10.6	-2.85	15.9	6.82
2	Sundara Rao	11.9	4.58	5.42	10.7	-2.97	18.5	7.02
3	Author	11.9	5.38	5.34	11.7	-3.64	18.7	7.55
4	Slater	..	..	..	..	..	..	8.55

The author's values for C_{11} and C_{44} are in good agreement with those of Sundara Rao while that for C_{12} is higher. According to the present measurements, Cauchy's relation is satisfied to a high degree of accuracy. It is interesting to note that the author's value for K is nearer Slater's (1931) value determined by direct experiment.

The author is very much indebted to Prof. S. Bhagavantam for his valuable guidance.

Dept. of Physics, T. SESHAGIRI RAO.
Andhra University,
Waltair,

November 22, 1949.

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RAMAN SPECTRUM OF METHYL METHACRYLATE GLASS

THE Raman spectrum of methyl methacrylate both in the liquid form and as glass has been investigated by Hibben¹ to elucidate the mechanism of polymerisation, but unfortunately, no photograph of the spectrum was reproduced. As a large transparent rectangular specimen of methyl methacrylate glass (Plexi-glass) supplied by the Imperial Chemical Industries Ltd., was available in the laboratory, the author undertook an investigation of its Raman spectrum. The specimen not being transparent in the ultra-violet region, its spectrum had to be excited by using the visible radiations of the mercury arc. The spectrum exhibited weak fluorescence between λ 4200 to λ 5000, but satisfactory spectrograms were obtained by using a filter of a strong solution of sodium nitrite.

In the photograph (Fig. 1), taken with a Hilger 2-prism spectrograph, after twelve hours' exposure, fifteen Raman lines are easily discernible, the frequency shifts being 231 (0,d), 295 (0,d), 360 (1,d), 491 (1,d), 606 (3), 817 (7), 982 (4,b), 1129 (1), 1176 (0) 1455 (5), 1598 (1), 1729 (5) 2876 (0), 2934 (3), 3001 (1) cm.⁻¹ The figures

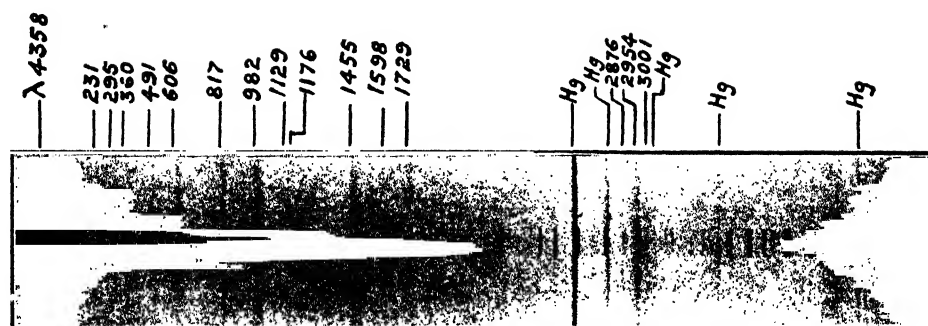


FIG. 1. Raman spectrum of plexi-glass.

in brackets represent rough estimates of the relative intensities of the lines. *b* = broad, *d* = diffuse. Besides confirming the frequency shifts already reported by Hibben, the three lines 231, 1176 and 1598 have been recorded for the first time. The appearance of the 1598 line in the spectrum of plexi-glass is very significant. It is in all probability due to C=C oscillation. The spectrum of methyl methacrylate liquid exhibits a line at 1638 cm^{-1} corresponding to C=C oscillation. Its absence in the spectrum taken by Hibben led him to conclude that the coupling of the molecules on polymerisation took place by the breaking of the C=C double band. This conclusion has to be revised in the light of the present investigation.

The author is grateful to Prof. R. S. Krishnan for suggesting the problem.
Department of Physics, M. M. PATEL.
Indian Institute of Science,
Bangalore,
November 24, 1949.

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SPECTRUM OF MONOBROMOBENZENE

FOLLOWING the work on the ultra-violet absorption spectrum of iodobenzene,¹ that of bromobenzene was studied under similar conditions. The absorption bands extending from λ 2300 to λ 2350 consist of about 150, appearing in a number of groups. As reported earlier by Walerstein² and also referred to by Sponer and Teller,³ the spectrum is a combination of the allowed transitions due to C_{2v} symmetry of C_6H_5Br and of the forbidden transitions of the benzene structure. The totally symmetri-

cal carbon vibrations of 933, 963 and 1020 in the upper state, the difference frequency 60 are evident in the structure of one set of the intense groups. The second set of intense bands displaced by about 520 cm^{-1} is also obtained. In addition, as observed in similar spectra of aniline,⁴ phenol,⁵ fluorobenzene,⁶ several of the intense heads show a splitting into doublets with an average separation of about 6 cm^{-1} . An additional difference frequency 221 cm^{-1} , not reported previously, is also established. The most intense band of the group in the region near ν 38900 corresponds to $(0+966+932)$, while the overtone $(0+2 \times 1020)$ is absent.

Full details will be reported elsewhere.
Andhra University, K. SREERAMAMURTY.
Waltair,
November 22, 1949.

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GEOGRAPHICAL INVESTIGATION OF THE GOKALPUR LAKE NEAR JUBBULPORE

THE important lake, situated north of Gokalpur village, is about two miles E.N.E. of Jubbulpore, over 1,300 feet above sea level and is put to multipurpose use. There is a depression, forming a natural rock basin in the granitic country with blocks of granite rising in some places above its surface. The north and the west are bounded by granitic hills, while on the north-west there is a natural

outlet. A bund has been constructed now and the water flowing through is used for irrigation purposes.

The lake has a maximum length of a mile in an east-west direction, while the maximum width in a north-south direction is four-fifths of a mile. It has, however, an irregular outline with extensions in the east, west and south. The low range in the north is studded with numerous granitic hills, about 100 feet high, the higher ones rising to about 150 feet. The western end is particularly well forested, while the eastern end is bare. The following trees, shrubs and climbers, deciduous in character, occur on the granitic hills above the north-western corner of the lake :—

Shorea robusta, *Butea frondosa*, *Garuga pinnata*, *Odina Wodier*, *Buchanania latifolia*, *Agoneissus pendula*, *Phyllanthus Emblica*, *Acacia Catechu*, *Helicteres Isora*, *Ziziphus Oenoplia*, bamboo, which is thin and wiry and *tendu*.

In the west there is a low and broken chain of hills, with the maximum height of about 100 feet. Towards the south-west corner there is high ground again, where a cluster of blocks of granite is to be observed. Adjoining the college buildings of the Mahakoshal Mahavidyalaya on the south-east is low ground traversed by streams feeding the lake, during the monsoon. It may be noted, therefore, that the shoreline in the north and some distance on the west is rocky, while in the south and south-east it is alluvial through the deposition brought by the incoming streams.

On the banks of the lake, aquatic vegetation, particularly water hyacinth (*Eichhornia crassipes*) along with *Carex Wallichiana*, grass and bushes are to be seen. The extent of this aquatic vegetation is variable. When the rocks come close to the shore, this aquatic vegetation is restricted in extent. When the rocks project into the lake no aquatic vegetation is seen. Aquatic vegetation, particularly water hyacinth, extends for a considerable distance towards the south, viz., the direction in which the stream flows from Gokalpur. The aquatic vegetation in the lake itself deserves study by a botanist.

On the west is a bund for controlling the flood level. Beyond the bund there is a channel which serves as an inundation canal during the monsoon. In the rainy season, the water rises by about 2 ft. as compared to the level in December, 1948.

Towards the south-eastern end the difference between the high and low water levels in December, 1948 was about 100 feet, but at other places this must vary with the slope. It may be noted that these banks are eminently cultivable in winter since the soil is rich in humus.

The lake is fed also by the Pariat tank, so as to minimise the fluctuations in lake level. It also supplies drinking water to Jubbulpore. During the monsoon, its water is used for rice cultivation and in the other seasons, for raising sugarcane and vegetables in the surrounding villages, viz., Katia, Bedla, Suhagi, Amkhera, etc.

The detritus from small streams pouring into it must be, gradually, making the lake shallower. It may be pointed out that those in charge of the lake would kindly see that it does not reduce in size or degenerate into a marshy depression as a result of this deposition. It is even likely that it has been already reduced in size in the south-east. Measures to counteract this effect are urgently called for. Fisheries and sport can be developed in this somewhat large reservoir so close to Jubbulpore. Finally, there is no denying the fact that the lake must have a salubrious effect on the climate of the neighbourhood.

Dept. of Geography, H. L. CHHIBBER.
Benares Hindu University,
July 29, 1949.

ON ORGANIC REMAINS FROM THE VINDHYANS (PRE-CAMBRIAN)

ATTENTION has been drawn to the occurrence of organic-like forms (Chapman,¹ M. R. Sahni,² Fox,³ Auden,⁴ and Rode⁵) in the Vindhyans. The most convincing evidence for it comes from the Suket shales from a horizon at the junction of the Lower and Upper Vindhyans, roughly equivalent of the Rohtas stage of the Son Valley, from which Chapman described some primitive brachiopods. These were later revised and redescribed under a new family *Fermoriidae* by M. R. Sahni.² The author has made a collection of rocks with structures suggestive of organic origin from the Lower Vindhyans of the Son Valley and Karwi area, Banda District, U.P., and a preliminary note (Misra⁶) was published on a previous occasion. The present note records three forms, indicative of organic origin.

1. GLAUCONITE GRAINS OCCURRING AS CASTS OF ORGANISMS

A detailed study of the sandy glauconitic limestones from the Lodhwara hill (25° 13'–80° 55') north of Karwi overlying the Bundelkhand granite, shows much glauconite in two distinct forms: (1) rounded, ovoid, and sausage shaped bodies (see Fig. 1)

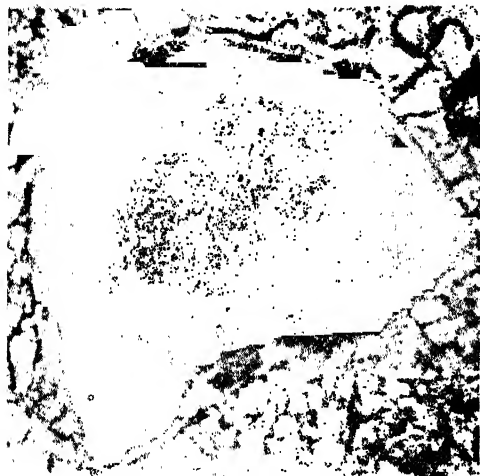


FIG. 1. A broken piece of glauconite infilling of an organism. $\times 110$. Loc.—Lodhwara Hill, Karwi, Banda District, U. P.

with clearly defined boundary walls and (2) irregular particles without any wall structures. The wall material in (1) is either transparent (Fig. 1) or (2) opaque consisting of carbonaceous matter. The carbonaceous nature was confirmed by strongly heating a thin slice on platinum foil. It may be noted that Sederholm⁷ figured bodies with boundary walls of carbonaceous matter from the Pre-Cambrian rocks of Finland and he considered them to be carbonised remains of very primitive plants. The forms I have figured therefore appear to be infillings of some organisms. A very striking result is obtained by treating uncovered slides with safranin. While the calcereous matrix and the detrital grains of quartz remain unaffected, the glauconitic bodies stain a brilliant brownish red.

2. REMAINS OF ALGA (FIG. 2)

The carbonaceous limestones collected from the Banjari quarries (south of Dehri-on-Sone, on the Dehri-Rohtas Light Railway) which come from a horizon towards the top of the Rohtas stage have yielded a microscopic verticillate alga with

a slender jointed stalk terminated by a globular head. The dark portions (seen in the photo) are carbonaceous and represent the original protoplasmic matter. The globular head consists of radiating black carbonaceous patches and represent fertile sporangia. The dark segments in the stalk appear to represent verticillate deciduous sterile branches (see Fig. 2). The earliest



FIG. 2. An alga (Dasycladaceae). $\times 110$. Loc.—Banjari, Shahabad District, Bihar.

known Dasycladaceae, are from Ordovician rocks: the genera described are *Cælosphaeridium*, *Cyclocrinus* and *Apidium* from the Ordovician of the Baltic region, and all these are characterised by a globular head consisting of radially spreading branches at the top of the axis as in the Vindhyan alga. It may be further noted that from the Ordovician of Spiti, Cowper Reed⁸ described *Cælosphaeridium shianensis* [= *Pasceolus* (?) *shianensis* Reed].

I am grateful to Prof. S. R. N. Rao, for identification of the alga and helpful suggestions.

Department of Geology, R. C. MISRA.
University of Lucknow,
Lucknow,
November 15, 1949.

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INFLUENCE OF VITAMIN C ON PHOSPHORYLASE

PHOSPHORYLASE was prepared by fractionating fresh potato juice with ammonium sulphate as described by Bourne, *et al.*¹ Glucose-1-phosphate was prepared by Hanes² method.

The phosphorylase activity was determined according to the method described by Green, *et al.*³

The reaction mixture contained 1 ml. of enzyme, 1 ml of citrate buffer (pH 6.0), 1 ml. of 0.1 M glucose-1-phosphate in citrate buffer of pH 6.0 and 1 ml. of each of the substances added, the total volume being adjusted to 6 ml. Temperature of incubation was 35°C. The results are presented in the following table.

Reaction mixture	Activity of phosphorylase expressed as mgm. of Ing. P. formed in the total digestion mixture in 10 minutes	Percentage inhibition
Phosphorylase alone	.. 0.4752	..
Phosphorylase + Vit. C (5 mgm.)	0.3268	31
Phosphorylase + Vit. C (5 mgm.) + Cu (15γ) as copper sulphate	.. 0.2099	56
Phosphorylase + Vit. C (5 mgm.) + Cu (15γ) + sodium oxalate (20 mgm.)	0.4752	0
Phosphorylase + Vit. C (5 mgm.) + Cu (15γ) + sodium diethyl dithiocarbamate (5 mgms.)	.. 0.4752	0
Phosphorylase + Vit. C (5 mgm.) + Cu (15γ) + 8-oxy-quinoline (5 mgm.)	0.4752	0

The results obtained are similar to those obtained in the case of other enzymes studied in this laboratory. Further work on the exact mechanism of the action of the substances in annulling the inhibition produced by vitamin C-Cu complex is in progress. Full details of the work will be published elsewhere.

Dept. of Biochemistry,
I. I. of Science,
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August 10, 1949.

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K. V. GIRI.

SYNTHESIS OF SACCHARIN FROM ANTHRANILIC ACID

THE most common method of preparation of saccharin is based essentially on the original method of Remsen and Fahlberg¹ through the conversion of toluene to o-toluenesulphonyl chloride and thence to the corresponding amide, and oxidation of the latter to saccharin. It has been reported² that during the war the Germans synthesised saccharin from anthranilic acid. The principal steps in the synthesis as described in the German patents³ issued to Ciba are: (1) diazotisation of methyl anthranilate and conversion to o-carbomethoxybenzenesulphinic acid, (2) conversion of the latter to o-carbomethoxybenzenesulphonyl chloride, and (3) preparation of saccharin (a) from the sulphonyl chloride by the action of ammonia or (b) directly from the sulphinic acid. Though all these basic reactions are known, scanty information is available in literature on them and particularly about the preparation of saccharin by this method.

A systematic study has now been made on the preparation of a number of sulphinic acids from the corresponding amino compounds as well as on the conversion of these sulphinic acids to sulphonamides either directly or through the corresponding sulphonyl chlorides. The existing methods have been modified where necessary to get optimum yields. The results have then been applied to the preparation of saccharin from anthranilic acid when about 70% yield calculated on anthranilic acid was obtained.

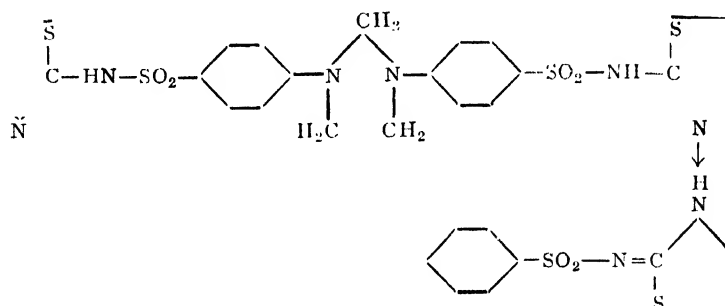
This method is worth considering as a possible manufacturing process in India. It may be noted that the chief difficulty in adopting the 'Remsen-Fahlberg process' for India is the non-availability of cheap chlorosulphonic acid, whose manufacture in India has not yet been established and is difficult. The economic feasibility of the present process, in which the plant requirements would be simpler, would depend upon the price at which anthranilic acid would be available. A detailed account of the work will shortly be published elsewhere. Organic Chem. Laboratories, N. B. DALAL. Royal Institute of Science, R. C. SHAH. Bombay, November 17, 1949.

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CHEMICAL STRUCTURE OF THE CONDENSATION PRODUCT OF FORMALDEHYDE WITH SULPHATHIAZOLE

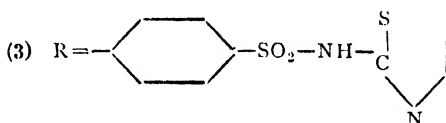
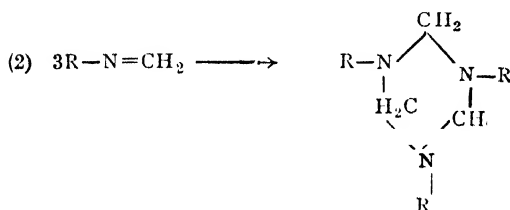
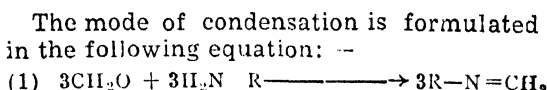
BHATNAGAR AND FERNANDES¹ have attributed a new mechanism of drug action to the formaldehyde derivatives of 2 *p*-aminobenzenesulphanilamidothiazole on account of their property of selective tissue localization in organs rich in reticulo-endothelial system of cells, and have envisaged the possibility of their application to those clinical conditions in which the pathogens are intracellularly located.



Chemical and analytical studies on this new chemotherapeutic agent so far^{2,3,4} point to the condensation of formaldehyde with sulphathiazole on 1 Mol : 1 Mol basis, resulting presumably in a polymer in which the sulphamyl and the aromatic NH₂ groups participate in loose combination with, perhaps, methylene bridge formation. Although the condensation product behaves as a Schiff's base—as for example in its reactions with SO₂ and NaHSO₃—its constitution as would fit into the summary formula (C₁₀H₉O₂N₃S₂) has not been found yet, owing to its insolubility in sodium hydroxide and the difficulty of splitting it with acids.

In our experiments on the chemical nature of this condensation product, an interaction took place between formosulphathiazole and Na₂CO₃ in a proportion (15.1 g. : 2.0 g.) which strongly indicated that this reaction was only possible if 3 Mols of formaldehyde were to condense with 3 Mols of sulphathiazole in the original product since we obtained a sodium salt of unusually high molecular weight (actual 801, found 802). Further proof that this was so was obtainable from colorimetric studies, after diazotisation and coupling, of different acid solutions of the sodium salt, prepared in the manner of sulpha standards with trichloroacetic acid, which on boiling for half an hour yielded approximately 3 times as much diazotisable substance as before the application of heat. On this basis and the study of physico-chemical behaviour we are led to suggest the following molecular configuration for formosulphathiazole, analogous to that of hexa-methylene-tetra-amine.⁵ Trimers of an allied nature, different in composition and structure, are known to exist.⁶

The mode of condensation is formulated in the following equation:—



In contrast to other aldehydes which give rise to normal Schiff's bases, the formation of cyclic trimethylene derivatives is peculiar to formaldehyde. The behaviour of formosulphathiazole as a Schiff's base in its reactions towards NaHSO₃ was found by us to be limited to equimolecular proportions. In view of the chemical structure proposed this would indicate that a weakly acid radical would only interact with one CH₂-N

grouping, no further decomposition taking place. A similar experience with hexamethylene-tetra-amine when reacting with HCl is obtainable. The formation of only a disodium salt with Na_2CO_3 in the presence of three reactive hydrogen atoms is explained by the existence of only two of these being free in $-\text{SO}_2-\text{N}-\text{C}$ groups, the third one having been isomerised to $-\text{SO}_2-\text{N}-\text{C}$ combination and having been stabilised by chelation.

Further work on the suggested chemical structure is in progress.

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November 22, 1949.

V. V. NADKARNY.
S. S. BHATNAGAR.
A. N. KOTHARE.
F. FERNANDES.

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FRIEDEL-CRAFTS ACYLATION OF METHYL β -RESORCYLATE : A NEW AND CONVENIENT SYNTHESIS OF 2-ACETYLRESORCINOL

By Friedel-Crafts acetylation of methyl β -resorcyate with acetic anhydride Desai, *et al.*¹ obtained methyl 2, 4-dihydroxy-5-acetylbenzoate (I) but no γ -isomer, methyl 2, 4-dihydroxy-3-acetylbenzoate (II). It is now found however, that besides (I) and a small quantity of methyl 2, 4-dihydroxy-3, 5-diacetylbenzoate, (II) is formed in considerable quantities (Ca 25% yield). The structure of (II) is established by hydrolysis and decarboxylation to 2-acetylresorcinol: it is quantitatively converted directly to the latter by heating with 10% sodium hydroxide solution on steam-bath for three hours. Similarly 2-propionylresorcinol could be obtained and the reaction thus appears capable of providing convenient syntheses of 2-acylresorcinols which are generally obtained indirectly by the method of Limaye,² by the hydrolysis of 7-hydroxy-4-methyl-8-acyl-coumarins.

This formation of (II) is however only to be expected for methyl β -resorcyate

gives 3-formyl derivative in the Gattermann reaction according to Shah and Laiwalla³ and the 5-hydroxy-coumarin derivative as the main product in the Pechmann reaction as shown by Sethna, Shah and Shah.⁴ Extension of this reaction for the syntheses of 2-acylresorcinols is in progress and results will shortly be published elsewhere.

Our grateful thanks are due to Dr. R. C. Shah for his kind interest in this work.

Organic Chem. Labs., P. L. TRIVEDI.
Royal Inst. of Science, SURESH SETHNA.
Bombay,
October 22, 1949.

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OCCURRENCE OF FUNGI INSIDE RICE KERNELS

THE study on the nature of action of the fungicides "Spargon" and "Phygon" in preventing loss of viability of paddy seeds in storage Ramiah and Padmanabhan,¹ (1949) has revealed that even apparently healthy seeds contain an internally borne fungus, which may be cultured artificially. The fungus that occurred most was *Trichoconis padwickii* Ganguly (Padwick and Ganguly,² 1945; Ganguly,³ 1946). The method employed in culturing the seeds and the results obtained are given below.

Four ounces of seeds of five local types, T. 90, T. 412, T. 812, T. 1145, and T. 1242, were kept in equilibrium with six different relative humidities in desiccators with sulphuric acid dilutions in the beginning of May, 1949. During the first week of June and the third week of July samples were drawn from the desiccators and tested for the presence of surface-borne and internally borne fungi. No distinction was made between the apparently healthy seeds and the small percentage of visibly spotted ones.

The seeds were made to stand for 1 hour in 10 c.c. of sterile water in test-tubes and washed in a single change of sterile water. They were then surface sterilised in mercuric chloride solution (one minute in 1:1000), washed again in four changes of sterile water and sown in thin oat-meal agar plates. A week after sowing, observation was taken on germination and the fungus, if any, growing from the seed, was identified.

The seeds germinate in 24 to 48 hours. After the emergence of the radicle and the plumule, when the latter is about a centimetre in length, a white tuft of mycelium grows out of the seed, at the base of the plumule, or in rare cases from the opposite end also. The mycelium grows slowly and establishes itself in the medium, forming characteristic sclerotia. The fungus is easily recognised by its compact light-olive gray colour, velvety surface as well as by its sclerotia (Fig. 1). Characteristic *Trichoniscus* stage of the fungus is readily obtained by cutting out a portion of the medium

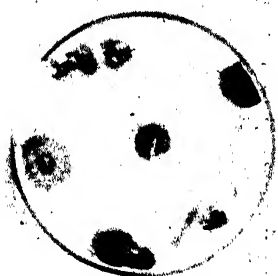


Figure showing seven seeds of T. 812 with pure growths of *Trichoniscus padwickii* $\times \frac{1}{4}$ Nat. size.

along with the fungus and placing the same in a moist chamber. A variant with light-pink thallus is also met with occasionally. This imparts the same pinkish colour to the medium.

Table gives the percentage of seeds with fungi growing out of them.

Type of paddy	Percentage of seeds infected by fungi			
	All fungi	<i>T. padwickii</i>	Other than <i>T. padwickii</i>	Unidentified fungi
T. 90	87.0	64.6	1.80	20.6
T. 1145	91.0	63.5	7.99	14.5
T. 812	93.0	76.0	8.7	8.3
T. 412	81.5	56.5	11.6	13.4
T. 1242	85.4	51.3	23.45*	10.75

* A number of seeds in this variety had spots; this explains the high percentage in Col. 3.

It will be seen that more than 80-90 per cent. of the seeds had harboured an in-

ternal fungus though they were apparently healthy. *T. padwickii* occurs most in these seeds (51-76%). The percentage of unidentified growth varied from 8 to 20%. The other fungi identified were *Curvularia lunata* Boedj. *Ophiobolus miyabeanus* Ito and Kuribay. (=*Helminthosporium oryzae* Breda de Haan) and *Nigrospora oryzae* (B. & Br.) Petch.

T. caudata has been reported to be associated with deterioration of paddy seeds in storage and from the condition created by the presence of the fungus in paddy stack, the disease was called "Stack-Burn," (Tisdale,⁴ 1922). Ganguly³ showed that *T. padwickii* is a weak pathogen on rice causing leaf and grain spot without doing great damage to the crop.

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Central Rice Research Institute,
Cuttack-4, Orissa.
October 13, 1949.

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THE EFFECT OF WATER-LOGGING ON THE CHEMISTRY OF SUGARCANE JUICE

EXCEPT for a few crops like paddy and jute, water-logging is detrimental to crop production. Knee deep water-logging in cane fields has been found to affect sugar recovery adversely and to create difficulties in manufacture.

In view of the importance of non-sugars^{2,4,5,6} in determining manufacturing qualities of juices, an examination of the changes brought about by water-logging in respect of these constituents was considered worth while.

Two varieties of cane (Co. 453 and B.O. 3) grown under water-logged conditions (submerged from July to September up to a maximum height of 4 ft.) were under examination. Samples were drawn in December and non-sugar constituents in their juices (Table I) compared with those in

TABLE I
Juice attributes and interlogging in canes

Sl. No.	Item*	Water-logged cane			Normal cane			Per cent change † due to water-logging
		Maximum	Minimum	Average	Maximum	Minimum	Average	
(a) Variety: C.O. 453								
1	Brix	19.00	18.30	18.73	22.50	21.05	22.08	- 15.1
2	Polarisation	14.03	12.31	13.15	18.49	18.23	18.37	- 28.3
3	Purity	76.70	65.80	70.28	86.89	81.93	83.27	- 15.6
4	Invert sugars	7.26	5.53	6.60	1.46	0.95	1.23	+436.5
5	Total colloids	6.45	5.79	6.20	5.00	3.90	4.36	+ 42.2
6	Gums	4.45	3.92	4.17	0.74	0.60	0.68	+513.2
7	Calcium pectate	0.33	0.24	0.29	0.18	0.14	0.16	+ 81.2
8	Total organic nitrogen	0.53	0.28	0.43	0.33	0.29	0.32	+ 34.4
9	"Harmful" nitrogen	0.47	0.26	0.39	0.23	0.22	0.22	+ 77.3
10	Ash	7.26	6.89	7.03	3.74	3.42	3.63	+ 93.6
11	P ₂ O ₅	0.12	0.09	0.11	0.11	0.07	0.10	+ 9.1
12	"Harmful" nitrogen per cent. total organic nitrogen	94.2	86.6	89.5	74.5	66.7	69.3	+ 29.1
(b) Variety: B.O. 3								
1	Brix	20.10	18.80	19.57	23.65	22.40	22.99	- 14.9
2	Polarisation	14.12	12.09	13.48	19.37	17.89	18.42	- 26.8
3	Purity	70.70	64.30	68.78	86.47	75.64	80.19	- 14.2
4	Invert sugars	7.66	5.74	6.67	2.70	1.30	1.80	+270.6
5	Total colloids	7.51	6.45	6.85	3.28	2.73	2.93	+133.7
6	Gums	4.28	3.31	3.85	0.68	0.53	0.58	+563.8
7	Calcium pectate	0.28	0.18	0.21	0.12	0.11	0.12	+ 75.0
8	Total organic nitrogen	0.56	0.33	0.46	0.37	0.24	0.32	+ 43.8
9	"Harmful" nitrogen	0.48	0.27	0.38	0.23	0.16	0.20	+ 90.0
10	Ash	7.12	6.26	6.78	3.03	2.82	2.02	+132.1
11	P ₂ O ₅	0.13	0.08	0.10	0.11	0.09	0.10	0.0
12	"Harmful" nitrogen per cent. total organic nitrogen	87.3	78.1	84.6	66.7	52.2	61.7	+ 37.1

* Item 4 to 11 are expressed as percents on total solids.

† Percentages refer to the average values.

juices from canes grown normally under otherwise identical conditions. The analytical methods employed were those referred to in a previous communication³ except for non-protein or "harmful" nitrogen¹ which followed that of Unverdorben and Spielmeyer.⁷

CONCLUSIONS

- (1) Against a 30% drop in polarisation, invert sugars, total colloids, gums, pectin, non-protein nitrogen and ash increase due to water-logging, the rise for invert sugars and gums being of a high order.
- (2) 90% of total nitrogen exists as non-protein (or "harmful") nitrogen, thus accounting for the poor technological properties of water-logged cane juices and losses in sugar recovery.

Thanks are due to the Government of Bihar and the Indian Central Sugarcane Committee for financing this work.

K. L. KHANNA.

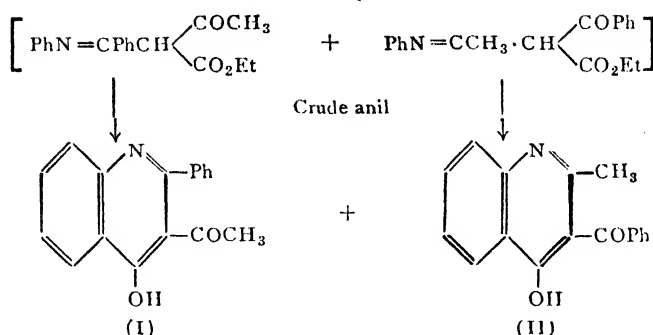
A. S. CHACRAVARTI.

Central Sugarcane Research Station,
Pusa (Bihar),
September 29, 1949.

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A NEW SYNTHESIS OF 4-HYDROXY-2-PHENYL-3-ACETYLQUINOLINE

THE condensation product of benzanilide imidochloride with ethyl sodioacetate on cyclization leads to the otherwise inaccessible 4-hydroxy-2-phenyl-3-acetyl-



quinoline (I).¹ It is now found that (I) could also be readily obtained by the application of the Conrad and Limpach method: the crude anil from aniline and ethyl benzoylacetate (prepared by using a trace of hydrochloric acid as a catalyst) cyclises to (I) in good yields by heating in diphenyl ether. This observation confirms also its constitution suggested by Desai and Shah.¹ In this reaction an isomeric product found identical with 4-hydroxy-2-methyl-3-benzoylquinoline² (II) obtained by Thakor and Shah² by Friedel-Crafts benzoylation of 4-hydroxy-2-methylquinoline, is also formed in small quantities.

It is interesting to note that in the above condensation with aniline, C-benzoyl ethyl acetoacetate gives good yields of (I) and (II); as with ethyl benzoylacetate only poor yields of the corresponding quinolines are obtained,^{3,4} although ethyl acetoacetate itself affords 4-hydroxyquinolines readily.³

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Organic Chem. Labs.,
Royal Institute of Science,
Bombay,
October 27, 1949.

1. Desai and Shah, *J. Indian Chem. Soc.*, 1949, **26**, 121. 2. Unpublished work. 3. *Ber.*, 1887, **20**, 944, 948; 1888, **21**, 521, 523; Limpach, *ibid.*, 1931, **64B**, 969, 970; 4. Elderfield, *et al.*, *J. Amer. Chem. Soc.*, 1946, **68**, 1212.

ON THE BIOLOGICAL CONTROL OF *STRIGA* SPECIES

In his note (*Curr. Sci.*, 1949, **18**) on the caterpillar of *Precis oritya*, Swinhæi L. feeding on *Striga* spp., a parasite of sugarcane and jowar, Mr. D. V. M. refers to Prof. Kumar's report (Kumar, L. S. S., 1939) on a certain caterpillar feeding on *Striga*

densiflora. Presumably Prof. Kumar recommended this caterpillar for the eradication of *Striga*. Early in 1935 the author² encountered a similar case of attack of *Striga lutea* (Lour) occurring on the hill paddy in Malabar, by the grubs of a beetle identified as belonging to Galerucine subfamily by the Government Entomologist, Coimbatore. The grubs were found to be highly predatory on *Striga* sparing no parts of it, including the stem, leaves and the pods. Large-scale rearing of this beetle for the biological control of *Striga* in infested rice fields was suggested by the author.

Agri. Res. Institute,
Coimbatore,
October 10, 1949.

P. UTTAMAN.

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MOUND-FORMING TERMITES AND THEIR CONTROL

DURING our investigation on white-ants and mound-forming termites, the following interesting observations have been recorded:

A mound is 'live', if repairs are done immediately on breaking open one of the 'towers'.

By placing a powerful magnetic compass at the centre of a mound, it is possible to locate the position of the 'Queen'. The 'Queen' invariably lies nearly parallel to the magnetic N and S in her cell which is on the NE or in a very few cases SW of the central point of the 'live' mound.

The 'fungus gardens' differed in different mounds not only in construction but

also in the manner of the proliferation of their hyphæ. Like an expert gardener the termites keep the hyphæ as if pruned to the very minimum.

In the control of termite mounds, benzene hexachloride, D.D.T., pyrethrum and crude oil, in various formulations, were used and a technique has been developed to get the best results by their application.

Thanks are due to Messrs. Geigy Insecticides Ltd., of Bombay, and other insecticidal concerns for their help and co-operation. Maharashtra Association P. J. DEORAS. for the Cultivation of Science, Poona 4, November 14, 1949.

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THE INFLUENCE OF AVAILABLE CARBOHYDRATES UPON AMMONIA ACCUMULATION BY *PENICILLIUM NOTATUM* WESTL.

THE role of available carbohydrates on ammonia accumulation with reference to *Aspergillus niger* van Tieghem, was first explained by Waksman¹ and later by Thakur and Norris² with reference to certain soil fungi.

The present work deals with a determination of the effect of the available carbohydrates on ammonia accumulation by *Penicillium notatum* Westl. obtained from the Indian Agricultural Research Institute, New Delhi.

Four litres of a medium composed of:—Peptone, 20 gm.; K_2HPO_4 , 1.0 g.; $MgSO_4$, 0.5 g.; KCl, 0.5 g.; $FeSO_4$, 0.01 g.; and dist. water 1,000 ml. 2% Dextrose (anhydrous, C.P.) was added to two litres of medium, and the other two litres were left without any dextrose. 100 c.c. of the medium was poured in 200 c.c. Erlenmeyer flasks and autoclaved at 15 lbs. pressure for 15 minutes. The rest of the procedure was almost the same as that adopted by Waksman.⁴

Dextrose in the medium had a marked effect on the accumulation of ammonia. In the medium lacking in dextrose though the growth of the fungus was slow, as was apparent from the dry weights of the

mycelium, yet large quantities of ammonia accumulated in the medium from the third to the sixteenth day (Fig. 1). Where dextrose was present, the ammonia accumulated in very small quantities, while the weight of the mycelium increased considerably till about the seventh day, when probably autolysis set in and the weight of the fungal matter began to decrease gradually.

Due to the heavy accumulation of ammonia in the medium lacking dextrose the reaction of the medium became more and more alkaline till at the end of the sixteenth day the pH was 7.6, the initial pH being 6.5. While in the medium containing dextrose the pH at the end of the sixteenth day fell to 5.1 possibly due to an increased production of organic acids.

It was found that greater amounts of amino-nitrogen were utilised by cultures to which dextrose was added, as manifested by the smaller amount of amino-nitrogen. The accumulation of ammonia however in such cultures is far less than what obtains in the sugar-free medium, since the nitrogen is synthesised into fungal protein (Fig. 1).

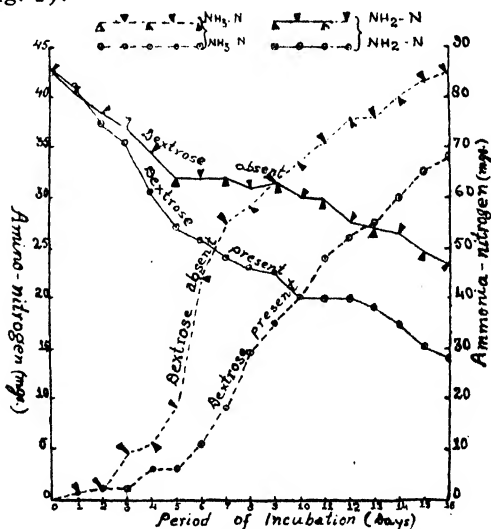


FIG. 1. Change in amino-nitrogen content of the medium and ammonia accumulation by *Penicillium notatum* during the period of incubation.

Thus the presence of available carbohydrates will be of ultimate benefit to the crops provided:

1. The amount of available carbohydrates is not very large, otherwise the micro-organisms will merely live on that source of energy, breaking up only as much of the

organic matter in the soil as is needed for the nitrogen metabolism. The higher plants would in that case only lose on account of the addition of carbohydrates since the micro-organisms would compete with them for the available plant food in the soil and would become injurious instead of being beneficial.

2. The soil is free from parasitic fungi. On addition of carbohydrates the parasitic fungi if present in the soil will only increase in numbers; this will be detrimental to the higher plants. This fact does not appear to have been fully appreciated by the previous workers.

Grateful thanks are due to Dr. R. K. Saksena for suggesting the problem and for his kind encouragement.

Botany Department, B. S. MEHROTRA.

University of Allahabad,

Allahabad,

May 18, 1949.

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THE MEGASTROBILUS OF

NIPANIORUHA GRANTHIA RAO, A. R.

A RECENTLY examined section of a silicified block from Nipania, Rajmahal Hills, Bihar (Jurassic), shows a petrified conifer megastrobilus measuring 1.6 cm. by .5 cm. The strobilus has been slightly distorted during fossilization. The only longitudinal section available of this strobilus (see Photo. 1) shows nearly 35 inverted seed-bearing scales arranged spirally and fairly compactly along an elongated axis. The ovules are dorso-ventral in form, approximately 1 mm. by $\frac{3}{4}$ mm. along their broadest plane, have curved micropyles and are sunk in seemingly fleshy scales. Whether these scales are single or double in nature is not clear. The ovules are cut in different planes, mostly longitudinal or oblique. Some are cut lengthwise along their dorso-ventral plane (a); others are cut longitudinally but perpendicular to the dorsoventral plane (b), and some others transversely (c). A few ovules are cut obliquely near their micropylar part showing its curvature (d) and one ovule shows its micropylar part in an obliquely longitudinal section (e). In one of the ovules (f), the section has passed more or less transversely across the micropylar apex showing the slit-like micropyle. Two-winged pollen



PHOTO. 1.—Longitudinal section of strobilus showing seeds cut, along their broadest plane (a), vertically at right angles to this plane (b), transversely (c), obliquely along the micropylar part showing the micropylar curvature (d), obliquely longitudinally along the micropyle (e), and across the micropyle (f); l, leaves; p, peduncle; vb, scale; vb, vascular supply of the cone.

PHOTO. 2.—A darker print of the basal part of the peduncle showing the attachment of the leaves.

grains are seen at the nucellar tips of some of the seeds. The chief importance however, of this interesting section is, that on the fairly thick and possibly fleshy peduncle, are borne two leaves (1) (see Photos. 1 & 2), one on each side. These leaves are remarkably like the needle-like decurrent leaves of *Nipanioruha granthia* Rao, A. R. (1946), a petrified conifer shoot with intercalary tuberculate swellings, described from Nipania itself and referred to the Podocarpaceæ. This organic connection between the leaves and the peduncle, leaves little doubt that the strobilus being described, was the female fructification of *N. granthia* Rao, A. R. There are also certain resemblances between this strobilus and a petrified Podocarpinean cone described from Nipania—*Nipaniostrobilus Sahnii* Rao, A. R. (1943). A more detailed comparison between the two will have to wait until more cones of the same kind and more satisfactory sections are obtained. The full paper will be published elsewhere, but the important organic connection between the leaves and the peduncle is recorded here.

Department of Botany, A. R. RAO,
University of Lucknow,
November 28, 1949.

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**SAGITTA BOMBAYENSIS, LELE AND
GAE—A SYNONYM OF SAGITTA
ROBUSTA DONCASTER—WITH A
RECORD OF SAGITTA PULCHRA
DONCASTER, FROM INDIAN COASTAL
WATERS***

IN the course of a detailed study of chæto-gnaths of the coastal waters of the different parts of India, some errors in the account of 'The common *Sagittæ* of the Bombay Harbour' by Lele and Gae (1936) have come to light. Russell (1936) and Kemp (1938) have pointed out the importance of *Sagitta* as an indicator of water movements which have in turn a bearing on fishery problems and the need for proper classification.

The form assigned by Lele and Gae to *Sagitta bombayensis* agrees in all systematic details with the widely distributed species—*Sagitta robusta* Doncaster. Sketches and tables by Burfield and Harvey (1926) show that *S. robusta* presents variations within the specific limit and that *S. ferox* Doncaster is a synonym of *S. robusta*. The following table will show that *S. bombayensis* agrees, practically in all characters, with *S. robusta*. The description of the latter is based on the details given by Doncaster (1902), Burfield and Harvey (1926), John (1933) and also on Michael's description of *S. ferox* (1919).

<i>S. bombayensis</i> , Lele and Gae	<i>S. robusta</i> Doncaster
Head is broad and short	Head broad and thick. The shape of the head varies according to the condition of prehensile spinæ
Collarette thick up to ventral ganglion	Collarette well developed extending to ventral ganglion and in some cases to anterior fin
Body opaque and bodywall muscular	Body firm and opaque, musculature strong
A thickened epidermis extends nearly all through the length of the body	Epidermis is thickened behind the head
The posterior fin is equally short as the anterior fin	The anterior fin may be as long as or longer than posterior, but generally slightly shorter
Posterior fin widest in the middle of its caudal half	Posterior fin widest behind the septum
Tail is $\frac{1}{4}$ the body in length	Tail is 25 to 32 per cent. of the body
Distance between genital openings is about 12 per cent. in large specimens	Distance between genital opening is 13 per cent (smaller specimens)
Anterior fin and posterior fin separated by $\frac{1}{3}$ the length of the fins	Length of the posterior fin 18 to 20 per cent. of the body. Anterior fin to posterior fin is 7.8 per cent. of the body. Hence distance between the fin is $\frac{1}{4}$ nearly
Prehensile jaws 9-10	Prehensile jaws 5-8
Anterior teeth 4-10	Anterior teeth 6-8
Posterior teeth 8-26	Posterior teeth 11-16

While describing species of *Sagitta*, it is customary to record the measurements of the collarette, ventral ganglion, anterior and posterior fins, distance between the fins, tail septum and seminal vesicles of a large number of specimens, as has been done by Michael (1919), Burfield and Harvey (1926), John (1933) and Subramaniam (1940). Lele and Gae do not observe this convention,

but base their description on three specimens, two of which are immature, although their species is stated to occur in swarms during the monsoon period. In instituting this species, they rely on only two characters—the number of prehensile jaws and teeth and the thick epidermis, while according to John (1933), the jaws and teeth fall off at times, while the thickened epidermis occurs also in *S. pulchra*, *S. ferox* and *S. regularis* (vide Doncaster, 1902).

S. robusta has been recorded from Madras (John, 1933) and the Gulf of Manaar (Varadarajan and Chacko, 1942). It has been described as a common species of *Sagitta* of the Indian Ocean by Doncaster (1902), Fowler (1906) and Burfield and Harvey (1926). Comparison of the specimens from both the coasts of India with Lele and Gae's species from Bombay, makes it evident that the latter is a synonym of *S. robusta* Doncaster as is *S. gardineri* Doncaster a synonym of *S. enflata* Grassi (vide Burfield and Harvey, 1926) recorded by John (1933) and Menon (1945) from the east and west coasts of India respectively.

A study of the plankton collections from Bombay enables me to record *S. neglecta* Aida, *S. tenuis* Conant and *S. pulchra* Doncaster, of which the last named is the first record from Indian Coastal waters.

Grateful thanks are due to Dr. H. Srinivasa Rao and to Dr. B. S. Bhimachar for helpful criticism, and to Dr. D. V. Bal, for the loan of the plankton samples.

Central Marine Fisheries

Research Station,
Calicut,

October 24, 1949.

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* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam.

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THE LATICIFEROUS SYSTEM OF *REGNELLIDIUM DIPHYLLUM* LIND.

THE latex was observed in the living plants of this rare member of the Marsiliaceæ grown from spores obtained by the late Professor Sahni from Brazil and successfully germinated at Almora and Lucknow. In Bombay the plants were grown on the fringe of shallow ponds holding temporary waters, in deep water reservoir, on moist soil, in muddy places, on dry soil watered daily, etc. The latex was more readily observed in plants growing terrestrially than in plants growing aquatically. This was rather unexpected, as in ferns the latex has not been known to occur. Possibly the earlier workers¹ on the plant using the preserved material took latex secreting cells for tannin sacs in the permanent preparations; or the material may have come from plants growing aquatically in which the latex dissolves slightly and turns acid as in the Musaceæ.

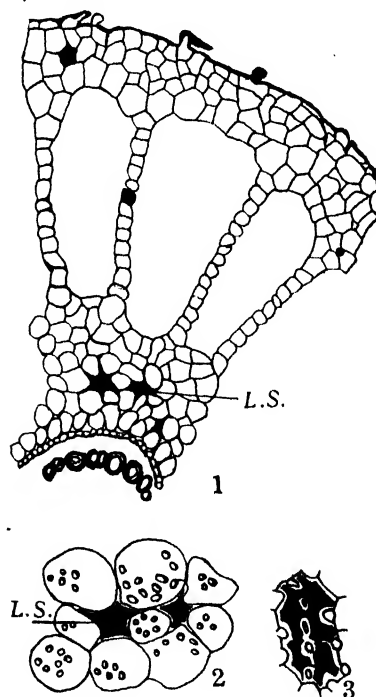


FIG. 1-3. *Regnellidium diphyllum* Lind.

FIG. 1. T. S. of petiole showing laticiferous sacs $\times 40$.

FIG. 2. A part of the inner cortex of stem showing latex sacs $\times 135$.

FIG. 3. Latex filling the cavities of the stellate parenchyma of the aerial diaphragm $\times 135$. L. S. Latex sacs.

In ferns the cells secreting tannins or phloëa-tannins are easily detected by iron

salts. In the genus *Marsilea* also the tannin secreting cells occur in the cortex of the stem and petiole,² but in the genus *Regnellidium* their place is taken by the cells secreting latex. This latex easily coagulates with KOH, dilute acetic acid, sulphuric acid, alcohol, etc., and gives the usual microchemical tests for latex. On breaking stem or petiole of a young plant, the latex oozes as a milky droplet which turns brown later. The latex does not contain starch grains as in some Euphorbiaceæ.

A preliminary examination of the laticiferous system in this plant showed that it mainly occurs in the inner cortical parenchymatous cells of the stem and petiole, in the phloem region, and in the subepidermal cells therein. It circulates through a channel and accumulates in the cavities of the air spaces above the stellate parenchyma of the aerial diaphragms in the ventilatory tissue of the stem and petiole.

The presence of latex and laticiferous tissue in *Regnellidium*, apart from being a novelty in ferns, introduces a reliable character for deciding the phylogenetic relationships, as in some families and subfamilies of angiosperms. For example, Jeffrey³ has shown that of the two sections of the Compositæ, the Tubulifloræ and the Ligulifloræ, the latter is considered to be more advanced among other reasons on the basis of the laticiferous tissue which is present in the Ligulifloræ but absent in the Tubulifloræ. The intermediate group between the two sections, Cynareæ, is transitional and has only vestigial laticiferous tissue. The laticiferous tissue here may also prove helpful in a similar manner in deciding the affinities of the Marsiliaceæ. But a discussion of the full significance of the laticiferous tissue system noticed here will be taken up on the completion of its detailed examination by Mr. M. Durairatnam of this laboratory.

Department of Botany, T. S. MAHABALE.
Royal Institute of Science,
Bombay,
August 15, 1949.

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INDICATORS IN CERIMETRY*

SETOPALIN was recommended by Knop¹ in the titration of iron with potassium permanganate, and Erioglaucin and Eriogreen were both employed by Furman and Wallace² in the same reaction, but with ceric sulphate as oxidant. They give greenish yellow solutions in hydrochloric or sulphuric acid upto 3N and transform into orange-red oxidation products on adding a drop of ceric sulphate. The colour change in every case is sharp and reversible. At the equivalence point, the colour change to the oxidised form is temporary, lasting only a few seconds. Addition of an extra drop of the oxidant deepens the colour, and makes it more permanent, without in any way affecting its reversibility. In this case, if 0.05 ml. is subtracted from the total volume of the oxidant, accurate results are obtained.

In all the following titrations the initial volume of the solution is adjusted to about 100 ml. after addition of 10 ml. of conc. hydrochloric or 3.5 ml. of sulphuric acid, thus making it 1.0 to 1.2 N with respect to the acid, and titrated in the cold with 0.05N Ceric sulphate in 1.5 N sulphuric acid. 5 to 6 drops of the indicator solution (0.2 per cent. in water) are added, sometimes at the start, and also towards the end of the reaction. Results reproducible to 0.02 ml. have been obtained in all cases. Some values chosen at random from a series of experiments are shown in the following table. It is believed that these readily obtainable indicators will help to bring Cerimetry into more general use.

Reaction	Volume of Ceric Sulphate in ml.			
	Required theoretical	Run using		
		Setopalin	Eriogreen	Erioglaucin
1 Ferrous iron	19.35	19.35	19.35	19.35
2 Feric reduced with stannous chloride etc.	18.80	18.80	18.82	18.80
3 Potassium ferrocyanide	13.40	13.35	13.30	13.30
4 Hydroquinone	17.50	17.48	17.48	17.50
5 Uranyl, on reduction with Zn and HCl and aeration	25.15	25.20	25.20†	25.15

† The indicator is added towards the end,

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Waltair, BH. S. V. RAGHAVA RAO.
November 1, 1949.

* Titrations involving ceric sulphate may be termed cerimetry on the analogy of permanganometry, dichrometry, etc.

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CHEMICAL EXAMINATION OF THE SEEDS OF *LUFFA GRAVEOLENS* ROXB. AND *LUFFA ECHINATA* ROXB.

Luffa greveolens Roxb.¹ known in Hindustani as *Bindal*, belongs to the natural order *Cucurbitaceæ*. It is found in U. P. and Bengal in India, in Abyssinia and in tropical Africa. The fruits are used in chronic bronchitis, in lung complaints and for several other ailments.²

brownish red in moderate thickness. The oils were examined chemically and gave:

TABLE I

The oils	<i>Luffa greveolens</i> Roxb. (A)	<i>Luffa echinata</i> Roxb. (B)
Specific gravity	.. 0.9594 (37 °C)	0.9157 (32 °C.)
Refractive index	.. 1.4740 (31 °C.)	1.4725 (31 °C.)
Saponification value	.. 197.20	143.0
Acetyl value	.. 75.06	27.30
Iodine value (Winkler's)	.. 96.70	94.52
Acid value	.. 47.75	63.96
Reichert Meissel number	.. 3.315	1.954
Hehner value	.. 92.45	95.45
Unsaponifiable matter	.. 0.2905%	2.756%

TABLE II

Constant	A			B		
	Mixed acids	Solid acids	Liquid acids	Mixed acids	Solid acids	Liquid acids
Refractive index at 31°	.. 1.4695	1.4780	..	1.4775	..	1.4710
Iodine value	.. 107.60	135.40	..	82.12	Zero	107.90
Acid number	.. 187.90	187.10	..	187.2	200.2	168.10
Mean molecular weight	.. 298.0	299.30	..	299.0	279.7	333.10
Percentage of saturated acids	..	20.78	..	..	..	25.0
Percentage of unsaturated acids	..	79.22	..	..	..	75.0
Titre value	24.25 C.	..	..	23.75 C.	48.0 C.	..

Luffa echinata Roxb.⁴ also known as *Bindal*, belongs to the same order and is reputed to possess medicinal properties similar to the other.⁵

The seeds from the fruits were extracted with petroleum ether (60-80°C.). The extracts, after complete removal of the solvent, gave in each case a fixed oil (yields being respectively 11.6 and 11.14%), which was yellow in thin layers and

Full details of the complete examination of the oils will be published later.

RAM GHULAM SINGH NIGAM,
K. C. PANDYA.

Chemistry Laboratory,
St. John's College,
Agra, JAGAT NARAYAN TAYAL.
Agra Medical College,
Agra,
October 10, 1949.

1. Chopra, R. N., *Indian Medicinal Plants*, 1933, 504. 2. Dymock, W. and Warden, C. J. H., *Pharm. J.*, 1890, 997. 3. Lakhani, J. V., and

Sudborough, J. J., *J. Ind. Inst. of Sci.*, 1916, 1, Part 17, 173-79. 4. Nadkarni, *Indian Materia Medica*, 1927, 519. 5. Kirtikar and Basu, *Indian Medicinal Plants*, 1933, 2, 1125.

REVIEWS

CRYSTAL GROWTH*

IN times past, well-developed clear crystals were a rare gift of nature and were highly valued. Their lustre and regularity of shape have been a source of pleasure to the layman through the centuries and a cause for speculation to the naturalist and philosopher. In recent years, however, the demand for single crystals has outstripped nature's bounty. The need for large crystals free from flaws for spectroscopy, piezo-electric measurements and the various purposes of the electric industry cannot be met from the diminishing natural sources, nor do those give a sufficient variety. This has led to researches on the methods of accurate control of crystallisation from the vapour phase, the melt, from supersaturated solutions and from hydro-thermal processes under high pressure simulating those in nature. The present brochure is the outcome of a general discussion on the theoretical and experimental aspects of artificial crystal growth held at Bristol in April 1949. Almost all the important workers in this field numbering more than sixty from England, U.S.A., Holland, Germany, Belgium and Switzerland contributed papers and took part in the discussion. The contributions are partly theoretical and partly experimental. The experimental papers fall fairly sharply into two classes—those dealing with rapid growth and those dealing with extremely slow growth.

The volume is divided in the main into four parts with the headings (1) Theory of crystal growth, (2) Nucleation and normal growth, (3) Abnormal and modified crystal growth and (4) Mineral synthesis and technical aspects, each being followed by a general discussion. The first part deals with the theoretical studies of the forms of equilibrium of crystals, surface structures of crystals, influence of dislocations on crystal growth and that of foreign material on habit modification. The principal contributors are, Stranski, Moliere, Burton, Frank and Egli. In Part II, the kinetics of crystallisation which includes two processes, namely the formation of three dimensional nuclei and the growth of these critical nuclei to microscopic dimensions has been discussed by Dunning and

others in some detail both from the experimental and theoretical standpoints. The numerous anomalies observed in the process of crystal growth and also the conditions under which crystal growth are modified are discussed in Part III. The last part of the symposium is mainly concerned with many of the recently developed methods for growing CaF_2 , LiF quartz and such other crystals of high commercial value. Anybody who is interested in the techniques of growing crystals will find this part and especially the contributions by Stockbarger, Menzies, Holden and Robinson very useful.

R. S. K.

Excited States of Nuclei. By S. Devons, *Cambridge Monographs on Physics*. (Cambridge University Press, Bentley House, N.W.1) 1949. Pp. 152 Price 12/6.

The volume under review conforms to the general plan of the Cambridge Monographs on Physics, and presents the results of most recent research on the excited states of nuclei mainly from the experimental standpoint. The experimental methods of study and the important and typical results obtained therefrom have been described in some detail. No attempt has been made nor is this to be expected in a small brochure of this kind, to give a comprehensive survey of all the experimental data which are accumulating at a very rapid rate. On the theoretical side, only the results of recent theories have been indicated without going into much detail.

The short introduction is followed by four chapters. The first two deal in turn with the excitation of "bound" and "virtual" states of nuclei. The term "bound states" is applied to the case if the only transition possible is by electromagnetic radiation, while the term "virtual states" is applied to the case if the dissociation from nucleus of one or more nucleons is energetically possible. The next chapter deals with the radiative transition between nuclear states, while the last chapter is devoted to the general problem of interpretation of data concerning nuclear spectra.

Specialists working in the field of nuclear physics will find the monograph particularly useful.

R. S. K.

* *Crystal Growth*.—Discussions of the Faraday Society (London), No. 5, 1949. (Gurney & Jackson, 98, Great Russell Street, London.)

Electricity and Magnetism: Classical and Modern. By G. B. Deodhar and K. S. Singwi. (Students' Friends, Allahabad and Benares), 1949. Price Rs. 15.

The book under review is intended to give "an introductory account of the main topics of electricity and magnetism". It consists of two parts, classical and modern, of which the former deals with electrostatics, magneto-statics and electromagnetism and the latter treats with the more recent developments since the discovery of the electron. The book is intended primarily to fulfil the needs of students going for the B.Sc. (Pass and Hons.) examinations and there is no doubt that it would eminently serve this purpose as most topics are dealt with in a manner readily capable of being reproduced in an answer paper. However, it is not certain that a student, reading only this book, can obtain a good understanding of the fundamentals of electricity and magnetism. The book reminds one of lecture notes rather than a text-book, ideas which are developed in later sections being freely used in earlier ones, with no indication to the reader as to where he can find these explained. There are a number of inaccuracies of statement and errors even in mathematics. For instance, one finds in p. 174 "The practical unit of mutual inductance is also henry. It can be defined as the e.m.f. in volts when the current is changing at the rate of one ampere per second". Again, on p. 182, the solution of case (2) of the growth of current in a circuit containing inductance, capacity and resistance is wrong and occurs from the fantastic assumption that, when the two roots of the auxiliary equation of a second order differential equation in t are equal ($-a$), then the solution is $ea^t(A+B)$. Misprints are also many, some of which occurring in the mathematics are likely to lead to confusion.

In spite of the above defects, the experimental portions are well described and the second half of the book, dealing with modern physics, contains a good account of the recent developments. It is to be hoped that these defects will be remedied in a later edition.

G. N. R.

The Adsorption of Gases on Solids. By A. R. Miller. (Cambridge University Press), 1949. Pp. viii + 133. Price 12/6 net.

The phenomenon of adsorption has been engaging the attention of scientific workers for some time from theoretical as well as practical points of view. In the latter category it has

found extensive application in a wide variety of fields, such as "outgassing" in the manufacture of discharge tubes and wireless valves, removal of the last traces of gas in the production of perfect vacuum, manufacture of gas masks, ion exchangers in water purification, etc., and the recently developed technique of chromatography. While the technical applications of adsorption processes are impressive and can be compared with those of the closely related phenomenon of catalysis there is still much to be done with regard to the theoretical aspect.

A few years ago all that was known of this phenomenon could be expressed by an empirical equation known as the Freundlich isotherm. A distinction had to be made between the purely surface action and the reaction taking place in the interior of the solid. Adsorption relates to the first, while "absorption" is used to denote the second. McBain (now Director of the National Institute of Chemistry, India) recommended the word "sorption" to cover both. Adsorption again is of two types, one due to physical or van der Waals forces, and the other due to chemical forces. The former is *van der Waals adsorption*, while the latter is known as *activated adsorption* or *chemisorption*.

A clearer understanding of the subject was made possible by the contributions of Langmuir relating to his famous unimolecular theory of film formation, followed by a host of others. At low pressures the phenomenon of adsorption is concerned with the formation of a film only one molecule thick. Multimolecular films are produced near the B. P. of the gas or below the critical temperature. Langmuir derived a general equation from first principles, which reduces to Freundlich isotherm under restricted conditions of temperature and pressure.

Langmuir's experiments showed the importance of keeping the surface clean in all studies of reactions between a solid surface and gas, and many of the discrepancies between experimental and theoretical results could be traced to the impurities which had not been removed. One of the earliest to recognize this fact and to pursue this aspect of the problem was the late J. K. Roberts of Cambridge, who initiated a scheme of research, the results of which were published in 1939 in a monograph entitled "Some Problems in Adsorption". After the death of Roberts the duty of bringing out a second edition was taken up by his collaborator A. R. Miller, according to whom "it was necessary to discard much of the original text

and to rearrange the presentation of the remainder to conform to the new material which was to be introduced".

The word "impurity" occurring in the very first sentence of the book sounds a little odd. This however is a minor criticism. The problem of adsorption is treated systematically first from the point of view of the kinetic theory of gases, followed by the modern statistical theories. Mobile and immobile films are distinguished, the effect of dipole interactions considered, as also the variation of the potential field provided by the adsorbing surface. One of the paragraphs is entitled "The kinetics of adsorption and evaporation in a mobile film on 110 plane of tungsten when each adsorbed particle precludes occupation of neighbouring sites". This should give an idea of the complicated nature of the problem. A sound mathematical equipment on the part of the reader is needed to appreciate the trends of modern research in connection with the phenomenon of adsorption. The book is meant for and strongly recommended to research workers and advanced students of physics and physical chemistry.

M. R. N.

Physical Chemistry. By G. V. Krishnamurti, (Ghantasala Publications, Eluru, Madras), 1949. Pp. 133. Price Rs. 2.

This book or booklet with its pompous title is meant to cater to the needs of Intermediate students, as its ten chapters cover the Intermediate syllabus only. As stated in the Preface "The explanations of important *theoretical* (author's spelling, not printer's devil, as the spelling is repeated in other pages in the text) principles are talked out as the author would to his own students." He has thus forgotten that his lectures are brought to the notice of a very much larger audience of varying degrees of knowledge and critical faculty, where he has no further chance of explaining or correcting his statements. All this implies that extreme care is needed in the publication of a book, especially a text-book. The author's language and style may be judged from a few samples of sentences chosen from different pages: "This book sets out to give an outline of the principles of physical chemistry in a clear and simple manner as to help the reader obtain an understanding of the essential concepts and ideas on the subject" (Preface). "We do not find atoms flying about singly in oxygen but the element oxygen is made up of molecules each of which is a pair of oxygen

atoms" (p. 8). "The hydrogen atom was chosen as the standard of comparison so that its weight was taken precisely as unity" (p. 9). "Gases are sparsely populated with molecules as thinly as Africa or Australia which would therefore admit of large immigration and extensive colonisation" (p. 10). "Of the three states of matter the behaviour of gases is in general much simpler" (p. 24).

As examples of scientific accuracy we have the following:— "These atoms are indivisible, indestructible, and existent from eternity to eternity" (p. 8). "As a few elements like silver do not combine with oxygen or displace it ..." (p. 4). The model answers worked out on p. 77 for calculating the degree of ionisation of NaCl and another substance are wrong; the values 1.92 and 3 represent not ionisation constant but the van't Hoff factor.

In addition there is the exasperating sentence on p. 4: "Refer to Intermediate Experimental Chemistry by the same author....." in the body of the text.

The Indian teacher has an enormous responsibility towards his students and his country. The least that he can do is to inculcate in the young minds the importance of accuracy, accuracy of facts and accuracy of expression. Judged from this standpoint this book falls far short of the ideal and cannot therefore be recommended to students.

M. R. N.

Surface Tension and the Spreading of Liquids.

By R. S. Burdon. (Cambridge University Press), 1949. Second Edition. Pp. xiv+92. Price 12/6 net.

This is one of the Cambridge monographs on Physics edited by N. Feather and D. Shoenberg. The major aim of this series will still be (as it was with the Cambridge Physical Tracts out of which this series of monographs has been developed), "the presentation of results of recent research, but individual volumes will be somewhat more substantial and more comprehensive in scope, than were the volumes of the older series. This will be true in many cases of new editions of the Tracts, as these are republished in the expanded series".

The monograph under review seems to be an exception to the above in that "no attempt has been made to do more than extend the tract by including some account of work published in recent years". Any specialist reader would find quite a few fundamental advances missing; the monograph extensively deals with the spreading of liquids but does not make any

reference to the theory of contact angles. Nevertheless, the book is written in a simple and elegant style and presents in an intelligible way many of the recent trends in the field of surface tension and spreading of liquids.

K. S. G. D.

Industrial Hygiene and Toxicology, Volume II. Prepared by a group of specialists under the editorship of Frank A. Patty, Director, Industrial Hygiene, General Motors Corporation, Detroit, Mich. (Interscience Publishers, New York, London), 1949. Pp. 535+1138. Price \$ 9.00.

Volume I of this invaluable work on industrial hygiene was reviewed in this journal a few months ago. It was devoted to a detailed survey of the conception of industrial hygiene from ancient time and described in detail the importance of environmental hygiene for the welfare of the workers and its contribution to industrial efficiency.

Toxicology is usually considered a very dry subject, but as dealt with by the eminent authors in Vol. II, it makes fascinating reading. The subject-matter is so beautifully classified and arranged that even lay persons can derive some pleasure in going through it. Immense pain has been taken to describe every kind of chemicals used in industries, small or large. Each individual or group of chemical has received adequate attention according to its importance, e.g., lead, arsenic, mercury, alcohols, aldehydes, various hydrocarbons, etc., have been described exhaustively in relation to their source, use, physiological response and toxic incidence and mode of hazards; others of lesser importance are grouped together and described in detail. The volume can be commended as indispensable not only to those interested in industrial organisation, but even to general medical practitioners, engineers and others associated with industrial establishments. The book is handsomely got up and well printed.

K. P. MENON.

The Sensory Line System and the Canal Bones in the Head of Some Ostariophysi. By Bertil Lekander. (Alb. Bonniers Boktryckeri, Stockholm), 1949. Pp. 131. Price not given.

The author has carefully described the development of the sensory nervous system and the canal bones of a number of species of fishes of the sub-order—*Leuciscus* *ratilus* L., *Phoxinus* *phoxinus* L., *Alburnus* *alburnus* L., *Tinca* *tinca* L., *Nemachilus* *barbatula* L., *Siluridae*, etc., of

the cryprinids and cobitids families. The development of the sensory system and the canal bones from the early formation in the embryo has been described in detail. Uptil now the available information has been based on studies on adult fishes only. In this investigation the author has shown the interrelation of the lamellar and the latro-sensory components of the canal bone and the genesis of the two components. Students of marine zoology will find the monogram very interesting.

K. P. MENON.

Fungi and Plant Disease. By B. B. Mundkur. (Macmillan & Co. Ltd., London). 1949. Pp. x+246, 130 figs.

Dr. Mundkur's book, the first to be written by an Indian, is meant to serve as a text-book for students and describes about 48 diseases of Indian crops. A summary of the salient features of the fungi precedes the detailed consideration of the types belonging to the different families. Under each type, the important diseases caused by it are described. The aim is not to be exhaustive, but only to rouse and sustain the interest of the undergraduate; in this, the author must indeed be said to have succeeded.

The first five chapters are devoted to a study of the structure of the fungi, their reproduction and metabolism, symptoms of diseases, and methods of studying them and classification and naming of fungi. The four main classes are reviewed in the next four chapters, and the diseases caused by them described. There is a short chapter on bacterial diseases and another on virus diseases. The last chapter discusses the control of plant diseases. Here the technique for the determination of wheat rust races is included, which might well have found a place in Chapter IV on methods of studying plant diseases. There are literature references to each chapter, but their worth might have been enhanced if cross references had been given in the body of the book. There is a good index.

The book is not without some blemishes. Of the 157 references, there are very few to the work done in Madras and Mysore, more than two-thirds being on work done in America and Europe. The oospores of *Phytophthora* *arecae*, *P. colocasiae* and *P. parasitica* are stated to be amphigynous, when the description should apply to the antheridia. Notwithstanding a few such instances of ambiguous terminology and some misprints, the book will be of real

service to those for whom it is intended. It is to be hoped that necessary corrections will be made and additional chapters written in its second edition.

The book has been well got up, on excellent paper, in bold type and moderately priced. It should find a place on the shelf of every student of mycology in India.

S. V. VENKATARAMAN.

Natural History of Marine Animals. By G. E. MacGinitie and Nettie MacGinitie. (McGraw-Hill Book Company, Inc., New York), 1949, Pp. 473. Price \$ 6.00.

All those interested in the natural history of marine animals will welcome the appearance of this book. It has for its subject the behaviour of sea animals in general, and of the Pacific Coast of North America, in particular. The authors have aimed at making the book useful not only to the students and the teachers engaged in a serious study of marine zoology, but also to the "layman uninitiated to the zoological terms". This extremely difficult task of satisfying both these classes of persons has been sought to be achieved firstly by reducing the scientific jargon to the minimum and secondly by giving easy definitions of unavoidable technical terms and Latin words; the result, however, is still a partiality towards student readers and it seems to be ambitious to expect the layman to patiently go through all the meanings and definitions, although, if he does so, he will find the information presented in the book very interesting.

There are 31 chapters in the book followed by a short list of useful publications relating to marine animals and an index. The first hundred pages, divided into twelve chapters, are devoted to a variety of general considerations namely food, comparison between the fauna of land and ocean, groupings of animals, animal relationships, growth rates, burrowing, variation and succession and geological records left by animal activities. One is bound to feel that in this part of the book there is too much of a jump from one subject to another; but probably this could not be avoided as it has not only to give the student an idea of the ocean as an environment for animals but also to provide the first lessons in general zoology to the uninitiated. The remaining part of the book deals with the various groups of animals inhabiting the sea from Protozoa upwards. Under each group is given a brief account of the distinctive characters of the same followed by a simple and interesting discussion of the

habitat, feeding, locomotion, reproduction, etc. of the typical forms with special reference to the local marine species. Those animals most frequently met with and those with most interesting habits have been chosen for purposes of discussion. A list of the general habits of phyla and classes has been appended at the end of the text, which is particularly useful to students. The book is well illustrated with a number of good photographs and drawings. The style is in general simple and pleasing, though sometimes a little pedagogic. The get-up and the print are excellent.

The keen interest that the authors have in the subject of marine zoology is evidenced by the profuse and lucid references in the book to their personal observations on the habitat and behaviour of many of the marine animals on the west coast of America. In spite of the local nature of some of the forms chosen for detailed reference, the general problems discussed are of such wide importance and interest that the book will be very useful to all students of natural science as well as to the general reader.

B. S. BHIMACHAR.

Principles of Insect Pathology. By Steinhilber. (McGraw Hill Publications in the Agricultural Sciences, 1949). Pp. x+757.

This book—a companion volume to the author's "Insect Microbiology"—deals specifically with the microbial diseases of insects as well as with certain antimicrobial diseases, injuries and abnormalities. Intended originally as a text-book for the use of students, specialising in Insect Pathology, this book has, since, proved itself highly valuable to lecturers and research workers in various fields.

The field of Insect Pathology deserves to be more widely known, as it has made vastly significant contributions to general biology, agriculture and medicine. The author's masterly treatment of it deserves high praise by everyone interested in biology and medicine.

Both as regards the study of diseases caused by injurious insects affecting crops and man and the biological control of insects by means of such diseases, this book will be of immense value to workers in such important fields as Medical Entomology, Insect Toxicology, Insect Physiology, Insect Ecology, Economic Entomology and Insect Taxonomy.

The subject has been dealt with in fourteen chapters under highly representative and practically useful aspects like Resistance and Immunity—Symptoms and Pathologies—

Bacterial Infections—Fungus Infections—Virus Infections—Protozoan Infections—Nematode Infections and Biological Control. The historical aspect of Insect Pathology has also been briefly narrated. Authors and subjects indices have been appended. Copious references to the various aspects of Insect Pathology are cited. The diagrams, photographs, photomicrographs and electron micrographs—are very well brought out, and highly descriptive and instructive in character.

In the chapter dealing with Applied Insect Pathology and Biological Control, Insect Control through the agency of pathogenic micro-organisms has been thoroughly discussed and it is well shown how the greatest stumbling block is the general ignorance about this specialised subject, and man's poor control over the various environmental factors. Nevertheless, the author recognises that whatever microbial control *does* take place in Nature, is of great economic importance.

The printing and general get-up of the volume are highly satisfactory and leave nothing to be desired.

B. K. M.

Annual Review of Biochemical and Allied Research in India, Vol. 18. (Society of Biological Chemists, India, Bangalore), 1947. Price Rs. 3 or 6 sh.

This publication reviews the researches in the field of Biochemistry and their applications to pharmacology and nutrition. Though appearing towards the end of 1949, it is purported to deal with the activities of 1947. Yet, not infrequently, citations to literature published in 1948 have been made; they are mostly confined to the author or to his immediate environs. Giri has, as usual, ably reviewed the work on enzymes under appropriate heads, though in just a 3-page review dealing with 12 references, 6 relate to 1948. Nutrition has been dealt with under 2 sections, general and animal nutrition. The section on General Nutrition reveals a more widespread activity during the year. Considerable attention has been given to the processing of foodstuffs, particularly soya bean, and to methods of conserving the existing stocks of grains. The fact that India loses annually 317,000 tons of rice through infestation and spoilage shows the magnitude of the problem. The various deficiency syndromes investigated during the year have been well summarised and help to give the reader a fairly cogent picture. "The use of hydrogen peroxide as a milk preservative is suggested by Banerji" (p. 14) gives the

impression that Banerji is the originator of the method whereas a study of his paper will reveal that Romani worked this method with success in Italy in 1944. The same paper has been reviewed admirably and without ambiguity on p. 61. Despite the expert treatment given to the Section on Animal Nutrition, the feeling is irresistible that much of what is reviewed does not relate to 1947 but to earlier years. Less than one-fourth relates to 1947. The chapter on Vitamins is really refreshing and represents a clear and succinct account of the work in this field without any of the blemishes apparent in the earlier sections. David's review of Pharmacology and Dastur's on Dairy Science are extensive and leaves the impress of a critical study of the work done in the respective fields.

Almost the first reaction on turning the pages of the *Annual Review* is that the output of work during the year 1947 has been very much on the low side, a feeling given vent to by some of the contributors. The Editorial Board could have done better in scrutinising the contributions and avoided such blemishes as citations to 1948 publications, wrong references (a glaring instance is reference 10 on page 7), summary of work done in 1941, 1942, 1943, etc. and absence of the year in most references to the section on Protein and Fat Metabolism. That some of these lapses are traceable to contributors who happen to be in the Editorial Board is regrettable.

S. RANGANATHAN.

SOUTH AFRICAN FISHERIES*

THE Nineteenth Annual Report of the South African Division of Fisheries issued by Dr. von Bonde, the Director, speaks of the gradual return to activity of the Department after the war. Extensive survey operations are reported on the West Coast between the Dassen Island in the South and the Orange River mouth in the north, bounded shorewards by the 100 fathoms contour, and seawards by the 300 fathoms contour to study and demarcate the profitable trawling grounds for the hake or the Cape stockfish (*Merluccius capensis*). It is of interest to note that there has been further development of the deep-sea fisheries as well as of the inshore fisheries of

* 1. *Annual Report of the Division of Fisheries, South Africa for 1947*. 2. *Investigational Reports*, Nos. 9, 10 & 11, Fisheries and Marine Biological Survey Division, South Africa. (Govt. Printer, Pretoria), 1949.

S. Africa owing to substantial expansion in the trawling and inshore fishing fleet. According to the report, the pilchard industry (now estimated to be dealing with about 102,500 tons of pilchard per annum) and the soupfin shark industry, which have both rapidly expanded in recent years, have begun to indicate needs for suitable measures of conservation. The laboratory investigations carried out by the Department include hydrological, biochemical and biological studies and some of the results have been published in the Investigational Reports.

Vitamin A content of the liver oils of the stockfish (*Merluccius capensis*), the Cape spiny dogfish (*Squalus acutipinnis*) and the vaalhaai or soupfin shark (*Galeorhinus zyopterus*) are dealt with by J. A. M. Archer in Investigational Reports, Nos. 9 & 10. Report No. 11 is a study of the food of South African fishes by D. H. Davies with notes on the general fauna of the area giving much valuable information on the food habits of the stockfish which is by far the most important commercial species in South Africa.

N. K. P.

OBITUARY

PROF. AUGUST KROGH

THE death of Prof. A. Krogh which occurred in Denmark in September 1949 has removed from the scientific world one of the most outstanding personalities in the field of comparative physiology. Krogh was born in 1874; he graduated in 1899 and soon made his mark as an original investigator by his Doctorate thesis on the skin and lung respiration in the frog, a work which was the forerunner of a series of brilliant studies in animal physiology. In 1916, he became Professor of Zoophysiology at Copenhagen, when funds were placed at his disposal for the establishment of a laboratory for animal physiology. This institution which he founded and is now world famous had Krogh as its chief till last year when he retired from official life, but not from scientific work to which he was devoted till the last days of his life. After retirement, he set up a small laboratory at his home to study problems concerning insect flight.

Among his numerous scientific achievements may be mentioned the elucidation of the role of capillaries in circulation, more especially the relation of muscular work to the filling of the capillary vessels. This piece of research formed the basis for the award of the Nobel Prize for Physiology and Medicine in 1920. Problems of marine biology, and of respiration and osmoregula-

tion in animals received his active attention wherein his demonstration that active uptake of ions from the surroundings plays a most important part in the salt regulation of the body fluids of animals deserves special mention. Apart from a large series of original papers, Krogh published important reviews from time to time; his books "Respiratory Exchange of Animals and Man" (1916), "Anatomy and Physiology of Capillaries" (1921&1929), "Osmotic Regulation in Aquatic Animals" (1939) and "Comparative Physiology of Respiratory Mechanisms" (1941) will continue to inspire and influence physiological work for several years to come. Krogh was honoured by many countries and was connected with various scientific bodies including the Indian Academy of Sciences of which he was an Honorary Fellow.

All those who have had the pleasure of knowing Krogh will remember his kindness and thoroughly international outlook which made his leadership of zoophysiological work at Copenhagen so very successful and they will realize in his death the loss of a most valued and active figure in scientific work and understanding, transcending all national barriers.

N. K. PANIKKAR.

SCIENCE NOTES AND NEWS

The Indian Academy of Sciences

The 15th annual meeting of the Indian Academy of Sciences will be held at the Royal Institute of Science, Bombay, from 29th to 31st December 1949. Professor Sir C. V. Raman will deliver the presidential address, while among the distinguished foreign scientists taking part in sectional meetings may be mentioned: Professors J. D. Bernal (England), O. E. H. Rydbeck (Sweden), Madame Joliot-Curie (France), Jean Frederic Joliot-Curie (France), A. H. Compton (U.S.A.), Hermann Mark (U.S.A.). There will be a public lecture by Sir C. V. Raman on the "Luminescence of Solids" as well as another one by Sir Robert Robinson later. Excursions have also been arranged for the participants.

The Indian Mathematical Society

The 16th Conference of the Indian Mathematical Society will be held at the Senate House, Chepauk, Madras, from the 26th to 29th December 1949, on the invitation of the University of Madras. This Society founded in 1907 is one of the oldest Mathematical institutions of the world and has been conducting biennial conferences at different centres of India. Madras has been chosen as the venue for the Conference this year after a lapse of over thirty years.

This Conference will be inaugurated by Sir C. V. Raman on Monday, the 26th December 1949, at 10-30 a.m. Among the delegates attending the Conference are Prof. M. H. Stone, former President of the American Mathematical Society, and Prof. Herman Wold, prominent statistician from Sweden. An exhibition of mathematical and scientific interest will be held at the Senate House during the first three days of the Conference.

The programme for the Session includes interesting symposia on "The Time-Series Analysis," "Fluid Dynamics," and "The Teaching of Mathematics". Popular lectures and film shows on topics of scientific interest are also arranged during the days of the Conference.

Bose Research Institute 32nd Anniversary

The 32nd Anniversary Meeting of the Bose Institute was celebrated on 30th November, 1949, when Dr. K. C. Mehta, Principal and Professor of Botany, Agra College, delivered the Eleventh Bose Memorial Lecture on "Control of Rust Epidemics of Wheat in India—a National Emergency", illustrated by lantern slides and maps. In the course of his lecture, Prof. Mehta observed that the best method of controlling rust in the long run is to cultivate resistant varieties.

In reviewing the research work of the Institute, the Director, Dr. D. M. Bose, mentioned that special importance is being given to the training of research workers in modern technical methods, like the use of high frequency techniques of powerful source of ultrasonic vibration, paper chromatography and radioactive tracers.

London's 1951 Exhibition

A tower from which radio messages can be sent to the moon will be a novel feature of the 1951 Exhibition to be staged on the banks of the Thames as the centre-piece of the Festival of Britain. It will embody a huge radar telescope with a revolving parabola which will gather in sounds from the sun, stars and meteors.

The largest dome in the world is also being built in Britain for the Exhibition. Made in aluminium, it will measure 365 feet across and 97 feet high and will form the central feature of the Exhibition.

The new dome, which will be built without any interior supports, will be named the "Dome of Discovery".

Another innovation will be a telecinema designed on entirely new principles and staging both film and television programmes. The audience will be placed both above and below the projection beam because television waves must travel horizontally.

Prof. Dr. Edward Condon

Dr. Edward Condon, Director of the United States National Bureau of Standards, is expected to arrive in this country by the end of this month, at the invitation of the Government of

India. He is attending the Indian Science Congress in Poona and thereafter will tour the country, visiting some of the research laboratories. It is learnt that he may be invited to accept the Directorship of the Indian Institute of Science, which has been vacant for some time.

Rajasthan Academy of Sciences

The Rajasthan Academy of Sciences, which was inaugurated in Pilani on 27th November 1949, seeks to uphold the cause and progress of science, both pure and applied, in Rajasthan. It is also proposed to start a Journal for the publication of articles of original research.

At a meeting of the "Foundation Fellows" of the Academy, Shri M. L. Schreff. B.A. Hons. (Cornell), M.S. (M.I.T.), was unanimously elected President of the Academy for 1949-50, Dr. B. N. Muiay, Ph.D. (Bombay) Vice-President, and Shri K. R. Ramachandran, M.Sc. (Wales), of the Department of Botany, Birla College, Pilani, Secretary.

Expert Committee's Recommendation on Medicinal Plants

At a recent meeting of the Medicinal Plants Committee of the Indian Council of Agricultural Research, the cultivation of 50 important plants has been recommended on an experimental basis in different climatic regions of India. Six regions have been selected and in each, one centre in the plains and another on a higher altitude are proposed. The centres suggested are: the Simla Hills in Himachal Pradesh, Gurdaspur and Manali in East Punjab, Coimbatore and Nilgiris in Madras, Poona and Panchgani in Bombay, Darjeeling in Bengal and Jorhat and Shillong in Assam.

Another recommendation made by the Committee is to test samples of indigenous drugs to ensure that the manufactured goods maintain a high standard of quality. Apart from being used internally in the country, some of these drugs are also exported. It has been suggested that certificates on behalf of the Export Control Organisation of the Commerce Ministry should be issued testifying to the quality of the stuff manufactured.

Specific for Black-Water Fever

The discovery of a medicinal plant, which is a reputed specific for black-water fever, in the

Rampa Agency tracts of the Madras Province was one of the important results of botanical investigations undertaken by the Botanical Survey of India, according to its annual report for the year 1947-48, just published. The plant, scientifically called, *Vitex peduncularis* var. *Roxburghiana*, was formerly known to exist only in Assam. Examination of other collections brought from the Rampa Agency has also revealed the existence of a number of plants, originally growing in distant regions like the Himalayas, Assam, Burma and the Andaman Islands.

Central Advisory Board on Forest Utilization

The Central Advisory Board on Forest Utilisation as reconstituted by the Government of India will consist of:—

Chairman: The Hon'ble Minister for Agriculture, Government of India;

Members: Secretary (or Joint Secretary) to the Government of India, Ministry of Agriculture; Inspector-General of Forests; The President, Forest Research Institute; The Director of Research, Forest Research Institute; one representative each of the Associated Chambers of Commerce and Industry, and the Federation of Indian Chambers of Commerce and Industry; two representatives of forest products industries, nominated by the Central Minister of Agriculture; (of these, one should represent the plywood industry); one representative of the Ministry of Industry and supply; the Director, Scientific and Industrial Research; One representative each of the Defence Ministry, the Indian Council of Agricultural Research and the Inter-University Board; two Chief Conservators of Forests from the Provinces (by alphabetical order of rotation); and two representatives of consumers nominated by the Central Government.

Secretary (Ex-Officio): Publicity and Liaison Officer of the Forest Research Institute.

The functions of the Board will be: (i) to advise on the assignment of priority to various items of research conducted at the Institute; (ii) to co-ordinate research with the needs of industry, agriculture and the general public; and (iii) to link research with the needs of the producer and the consumer.

